CHEMICAL QUALITY OF WATER RESOURCES IN THE ALLEGHENY RIVER AND CHEMUNG RIVER BASINS NEW YORK 1953-1954

by

F. H. Pauszek

Prepared cooperatively by the Geological Survey,
United States Department of Interior and the
New York State Department of Commerce

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ABSTRACT

This is the second in a series of reports on the chemical quality of water resources in selected areas of investigation in New York State. It covers the period of April 1953 to September 1954. Data on the chemical quality of the Allegheny River at Red House, Chemung River at Chemung, their tributaries, ground waters in those areas and selected surface waters in other areas of the Susquehanna River Basin are presented in tabular and illustrated form.

The Allegheny River at Red House has a drainage area of 1,690 square miles spread over the northern part of Pennsylvania and southwestern part of New York. Throughout the period of study, chemical quality of the Allegheny River and its tributaries reflected changes in discharge, chemical composition of the drainage area, and pollution. Sodium and calcium were the predominant cations and bicarbonate the principal anion in solution. Lesser amounts of magnesium, chloride, sulfate, fluoride, and nitrate were observed. Generally, on the basis of mineral content, water from the Allegheny River would be suitable for industrial and agricultural uses.

Chemung River at Chemung has a drainage area of 2,530 square miles. Formed by the confluence of Cohocton and Tioga Rivers, Chemung River flows only a short distance in New York, crosses into Pennsylvania and joins the Susquehanna River below Sayre, Pennsylvania. During the period of study, chemical quality of Chemung River and its tributaries

was influenced by discharge and chemical composition of the drainage area. Calcium, magnesium and to a lesser extent sodium were the predominant cations present in the water, together with equivalent concentrations of bicarbonate, sulfate, chloride, and other anions. However, on the basis of mineral content, water from the Chemung River would be suitable or could be made suitable, with treatment, for many uses.

A limited number of chemical analyses are available of ground waters in the Allegheny and Chemung River basins. The data are not based on a comprehensive study of ground-water resources in the areas, but only represent the chemical quality of ground water already in use and that may be expected in the same areas.

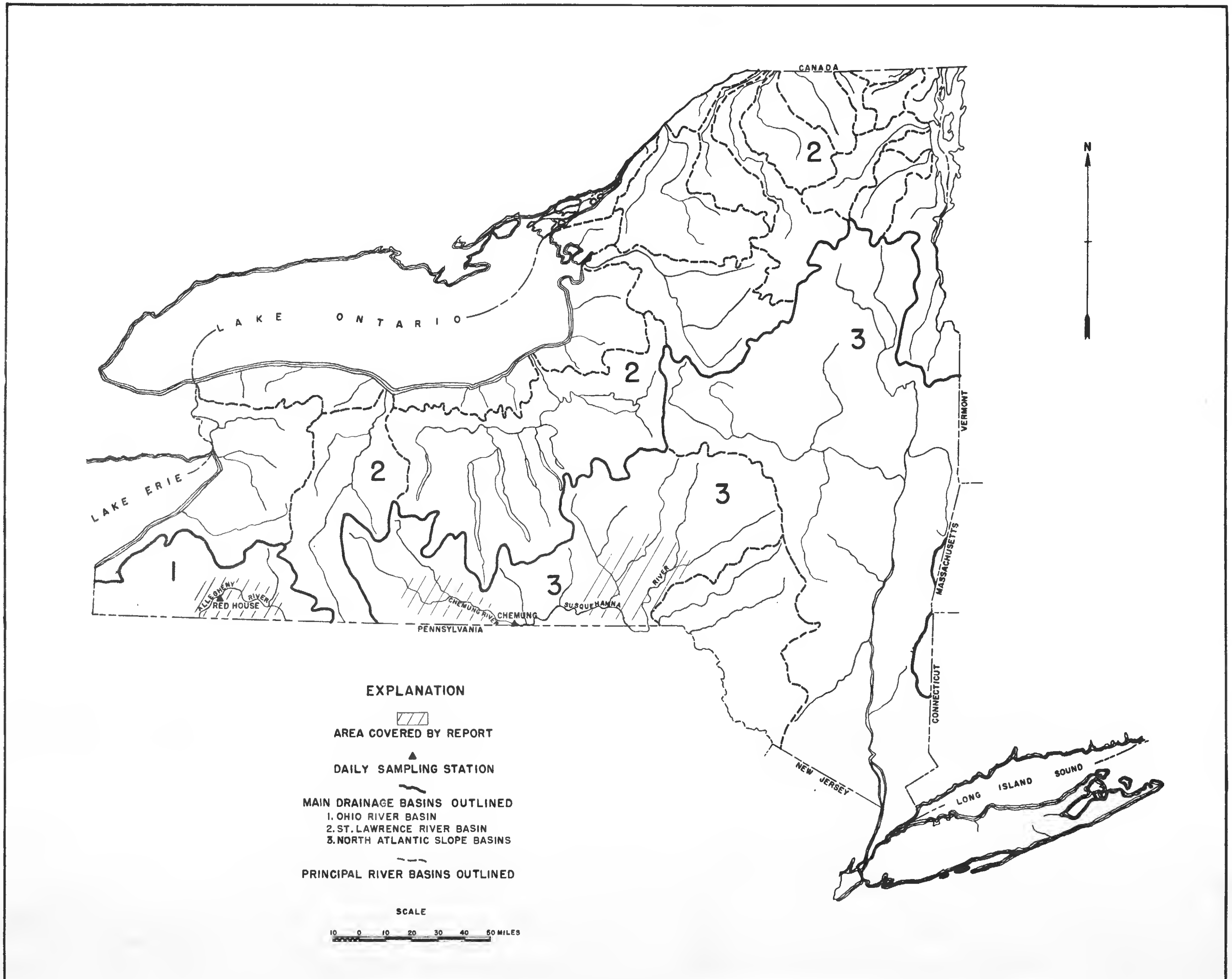

Figure I. Map of New York State showing Drainage Basins and areas of study.

CHEMICAL QUALITY OF WATER RESOURCES IN THE ALLEGHENY RIVER AND CHEMUNG RIVER BASINS

by

F. H. Pauszek

INTRODUCTION

Chemical quality is a measure of the utility of water for industrial, agricultural, public water supply and recreational purposes. Some waters may be hard and are objectionable for domestic and industrial uses because of their soap-consuming properties, formation of precipitates, and scale deposition. If iron and manganese concentrations exceed about 0.3 part per million, discoloration and deposition will normally take place. Corrosiveness in water increases the cost of maintenance of utility lines. Excessive amounts of dissolved solids, alkalies, boron, bicarbonate, and chloride in water will make it unsuitable for irrigation. Fluoride in water has gained prominence in recent years because of its effect on dental health of children. Concentrations greater than 1.5 ppm in a public water supply are considered undesirable. Surface waters having a dissolved oxygen content of less than 5 ppm are considered by many authorities as unsatisfactory for the propagation of game fish. These are only some of the effects that may take place. Whether or not they do, can be anticipated beforehand if the chemical quality is known. However, if a water supply is found to be unsatisfactory, it still may be usable if proper treatment is applied. Here, too, a knowledge of the chemical quality is a prerequisite for the selection of a suitable treatment process.

This report is the second in a series of reports on the chemical quality of water resources in New York State. The first report, CHEMICAL QUALITY OF WATER RESOURCES OF THE CONEWANGO CREEK BASIN by W. A. Beetem included data collected during a period of study, October 1951 to September 1952. This report incorporates data collected during 1953-1954 on chemical quality and temperature of the Allegheny, Chemung, and Susquehanna Rivers and their tributaries. Chemical data of selected ground waters in these river basins were also collected during the same period and are included in this report. Similar reports are planned for succeeding years based on investigations made in other areas throughout the State.

ACKNOWLEDGEMENTS

The program of study of the chemical quality of water resources in New York is conducted by the U. S. Geological Survey in cooperation with the New York State Department of Commerce.

Acknowledgements are extended to Harold Keller, former commissioner of Commerce, Edward T. Dickinson, present commissioner of Commerce, and Ronald B. Peterson, director of the Bureau of Industrial Development, New York State Department of Commerce. Records of discharge were furnished by A. W. Harrington, district engineer, and geologic data was furnished by E. S. Asselstine, geologist in charge, of the Surface Water Branch and Ground Water Branch, U. S. Geological Survey, Albany, New York, respectively. Chemical analyses were made by personnel of the Quality of Water Branch laboratory, U. S. Geological Survey, Washington, D. C. The program was under the general supervision of S. K. Love, Chief, Quality of Water Branch, and the immediate supervision of F. H. Pauszek, district chemist, New York-New England.

CHEMICAL AND PHYSICAL CHARACTERISTICS OF WATER

In order to define the chemical quality of water, quantitative analyses are made of selected physical and chemical characteristics. The results are then expressed in descriptive units and terms, which may not be familiar to everyone. Accordingly, some of these units and terms are discussed below.

In this report, and generally in water practice, quantities of chemical constituents dissolved in water are reported in parts per million by weight. A part per million is a unit of weight in a million unit weights of water. In the metric system this would be one milligram in a liter of water, if the liter of water weighed one kilogram. For those accustomed to thinking in grains per gallon, results in parts per million can be converted to grains per U. S. gallon by dividing by 17.12.

Hardness and its opposite, softness, are common characteristics of water. A literal interpretation of these terms is misleading. Physically, a water is hard if excessive amounts of soap are required to form a lather and if a curd is deposited. In contrast, soft water forms a lather readily. Chemically, hardness is caused for the most part by calcium and magnesium and to a lesser extent by other mineral salts in water. In terms of numerical values, a water supply having a hardness of 60 ppm or less is considered soft, that is it lathers easily and very little scum is formed. Between 61 and 120 ppm, more soap is consumed in the formation of a lather and an appreciable amount of scum is observed. Such a water is considered moderately hard. In a water having a hardness of 121 ppm or more the consumption of soap and formation of a curd is excessive. Such a water would be considered hard.

Another characteristic of water is its ability to conduct an electric current. The amount of current varies with the type and concentration of chemical constituents in solution, their ability to conduct a current and movement in solution which is influenced directly by temperature. In water analysis, conductance is measured as specific conductance, that is the conductance per unit cross sectional area of solution. This is expressed in units of micromhos at a specified temperature, usually 25°C. This measurement does not reveal specific chemical constituents in water but is helpful in estimating the total concentration of mineral matter in solution. A high specific conductance, for example 700 micromhos, indicates a large concentration of dissolved mineral matter, whereas a conductance such as 100 micromhos indicates a water comparatively low in mineral content.

Acidity and alkalinity are general terms familiar to everyone. In water, acidity, as measured on the pH scale, is caused by uncombined carbon dioxide, and/or the hydrolysis of salts of strong acids. Mine and industrial wastes are the usual sources of free mineral acids. Alkalinity, as used here, is caused by the presence of the bicarbonate, carbonate, and hydroxyl ion. One of the end products of these chemical interactions is the formation of hydrogen-ion in solution. Numerically, such concentrations of hydrogen-ion are expressed as values of pH. This is the negative logarithm of the hydrogen-ion concentration in moles per liter of solution. The range of the pH scale is from 0-14. Water having a pH value of 7 is considered neutral, that is neither acid nor alkaline. Values of pH above 7 indicate increasing alkalinity and below 7 increasing acidity.

Color in water is considered to be the visual effect due to material in solution in a clear sample. Color in water is determined indirectly by a comparison with color in a solution produced by selected chemical reagents. The numerical expression is in terms of the concentrations of these reagents. Generally, a number without any unit designation is used. A color value in water from 1-5 is almost imperceptible to the naked eye. From a color of 5 upward shades of straw yellow are observed. In highly colored waters of 50 and above, the color has the appearance of varying shades of brown.

Oxygen consumed is an approximate measure of the amount of oxidizable material present in filtered and unfiltered samples of water but does not distinguish between organic and inorganic material. However, high values for oxygen consumed when considered in conjunction with other determinations will indicate the possible presence of large amounts of readily oxidizable organic material in water.

MINERAL MATTER IN WATER

Basically, water is composed of two parts of hydrogen and one part of oxygen. However, water in its passage from the atmosphere, over the earth's surface or percolating through the ground undergoes many changes in chemical character. First, it absorbs the gases of the atmosphere, such as oxygen, nitrogen, ammonia and carbon dioxide. These gases in solution, especially carbon dioxide, increase its solvent activity. Upon coming in contact with soils and rocks, water dissolves any soluble mineral matter present. Iron, calcium, magnesium, sodium, potassium, bicardonate, chloride, and sulfate are some of the chemical

elements leached from the mineral matter found in the soil mantle and rocks. The kinds and amounts of the various constituents determine the chemical quality of water.

Listed in the following table are chemical constituents usually found in water, their occurrence, effects and user concerned.

WATER TEMPERATURE

Water is an excellent heat exchange medium. This property of water is used extensively in air-conditioning and for various other cooling purposes. Temperature is an indirect measure of the capacity of water to absorb heat.

Generally, temperature of surface water varies more than that of ground water. In shallow streams, water temperatures will generally follow diurnal (day to day) changes in air temperatures. The mean monthly temperature of surface water is generally within a few degrees of the mean monthly air temperature when the air temperature is above the freezing point. In deep rivers there may be considerable variation between air and water temperatures, as well as temperature differentials from top to bottom. As the temperature of the top layers is lowered, they will sink to the bottom and will be replaced by warmer layers, This phenomenon occurs because as water becomes colder it becomes more dense. At approximately $4^{o}C$ water reaches its maximum density. From 4^{o} to $0^{o}C$ water becomes lighter, and the bottom layer will again rise to the top. This turn-over or thermocline effect takes place in the spring and fall each year in streams, lakes, ponds, and reservoirs.

TABLE 1. - CHEMICAL CONSTITUENTS IN WATER, OCCURRENCE, EFFECT AND USER CONCERNED

CHEMICAL CONSTITUENTS	OCCURRENCE	EFFECT	USER CONCERNED
Silica (SiO_2)	Found in all natural waters in varying concentrations. Ground waters, generally, contain more silica than surface waters.	Forms boiler scale and deposits on turbine blades.	Industry
Iron (Fe) and Manganese (Mn)	In practically all natural waters. Generally, smaller amounts are found in surface waters than in ground waters.	Concentrations of about 0.3 part per million or more stain laundry, porcelain fixtures and other materials.	Industry and public water supplies
Calcium (Ca) and Magnesium (Mg)	In all natural waters. Highest concentrations found in water in contact with limestone, dolomite, and gypsum.	Soap consuming. Forms an insoluble curd and deposits in pipes and boiler tubes.	Industry and public water supplies
Sodium (Na) and Potassium (K)	In all natural waters. In very low concentrations of alkalies, concentrations of sodium and potassium are about equal. As concentrations of alkalies increases proportion of sodium increases.	Large amounts may cause foaming in boiler operation. In irrigation waters, large amounts degrade the soil.	Industry, public water supplies, and agriculture
Bicarbonate (HCO_3)	In all natural waters. Larger concentrations present in waters in contact with decaying organic matter, and carbonate rocks.	Large amounts may affect taste of drinking water. Large quantities in combination with sodium degrade the soil.	Industry, public water supplies, and agriculture

TABLE 1. - CHEMICAL CONSTITUENTS IN WATER, OCCURRENCE, EFFECT AND USER CONCERNED--*Continued*

CHEMICAL CONSTITUENTS	OCCURRENCE	EFFECT	USER CONCERNED
Sulfate (SO_4)	Present in most natural waters. Larger amounts in waters in contact with gypsum and shale.	In conjunction with calcium and magnesium forms permanent hardness and hard scale in boiler operation.	Industry and public water supplies
Chloride (Cl)	Present in most natural waters. Larger amounts in contaminated waters.	Taste of drinking water affected when amounts of more than about 250 ppm are present. Corrosiveness is also increased.	Industry and public water supplies
Fluoride (F)	Present in most natural waters in small concentrations.	About 1.0 ppm believed to be helpful in reducing incidence of tooth decay in small children. Believed to cause mottled enamel on teeth at higher concentraions.	Public water supplies
Nitrate (NO_3)	Present in most natural waters. Contamination by sewage and organic material increases quantity present.	Small amounts have no effect. Forty-four ppm or more reported to produce methemoglobinemia in infants. May indicate pollution.	Public water supplies

Water from these sources may vary in chemical and physical quality. Organic and precipitated mineral matter as well as sediment that has settled to the bottom may rise if there is sufficient turbulence. Many public water supplies have an increased amount of iron and manganese during these periods of turn-over.

CHEMICAL QUALITY OF SURFACE WATERS IN NEW YORK STATE

ALLEGHENY RIVER AT RED HOUSE

Allegheny River has its origin in Potter County, Pennsylvania. Flowing westward, it crosses into McKean County, and near Port Allegheny the direction of flow becomes northwesterly towards the New York-Pennsylvania State line. About 3 miles south of Portville, New York, the Allegheny River crosses into New York State. Traveling only about 50 surface miles in New York State it passes through Salamanca and Red House, then south again into Pennsylvania. At Red House, the Allegheny River drains an area of 1,690 square miles that includes many of the oil fields in northern Pennsylvania and southwestern New York.

During the period of October 1953 to September 1954, water samples were collected daily from the Allegheny River at Red House, New York, and analyzed. Results of chemical analyses of composite samples are given in table 2.

The chemical quality of the Allegheny River at Red House was influenced by stream discharge, mineral composition of the area drained, oil wastes, and industrial pollution.

During the period of December 1953 to June 1954, the concentration of dissolved mineral matter was less than during the periods of

October to November 1953 and July to September 1954. For the same periods, discharge was comparatively higher during the winter and spring months than during the summer and fall seasons. With increased discharge, concentrations of dissolved mineral matter decreased. Mean monthly discharge data and dissolved solids during October 1953 to September 1954 are shown below:

Period	Mean Monthly Discharge (cfs)	Mean Monthly Dissolved Solids (ppm)
October, 1953	211	489
November, 1953	753	412
December, 1953	2,277	182
January, 1954	2,495	207
February, 1954	4,162	152
March, 1954	4,884	119
April, 1954	6,365	102
May, 1954	3,356	166
June, 1954	1,412	193
July, 1954	307	409
August, 1954	226	542
September, 1954	210	599

Daily specific conductance data (a measure of dissolved solids) as well as mean daily discharges are available for the periods. In fig. 2 fluctuations of daily specific conductances and mean daily discharges during 1953-1954 are shown. Approximate concentrations of dissolved solids can be calculated by using a factor of 0.6 times specific conductance in micromhos.

Preliminary analyses of water samples from the Allegheny River indicated that a large proportion of mineral matter was sodium chloride. Consequently, chloride analyses were made on all daily water samples to

OHIO RIVER MAIN STEM

Table 2. - ALLEGHENY RIVER AT RED HOUSE, N. Y.

LOCATION.--At highway bridge about 400 ft. downstream from gaging station in Red House, Cattaraugus County.
DRAINAGE AREA.--1,690 square miles.
RECORDS AVAILABLE.--Chemical analyses: October 1953 to September 1954.
Water temperatures: October 1953 to September 1954.
EXTREMES, 1953-1954.--Dissolved solids: Maximum, 624 ppm Sept. 21-24, 28-30; minimum, 82 ppm Apr. 11-12, 18-20.
Total hardness: Maximum, 256 ppm Aug. 26; minimum, 28 ppm Mar. 2-5.
Specific conductance: Maximum, 1,480 micromhos Aug. 26; minimum, 109 micromhos Mar. 2-5.
Water temperature: Maximum, 80°F July 14; minimum, 31°F Dec. 19.
REMARKS.--Records of specific conductance of daily samples from October 1953 to September 1954 available in Quality of Water Branch district office, Albany, N. Y. Records of discharge for water year October 1953 to September 1954 available in Surface Water Branch district office, Albany, N. Y.

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Chemical analyses, in parts per million, water year October 1953 to September 1954

Date of collection	Mean discharge (cfs)	Silica (SiO_2)	Iron (Fe)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Dissolved solids (residue on evaporation at 180°C)	Hardness as $CaCO_3$ Total	Hardness as $CaCO_3$ Noncarbonate	Specific conductance (micromhos at 25°C)	pH	Color	Oxygen consumed Unfiltered	Oxygen consumed Filtered
Oct. 1-2,4-7,10,1953	225	2.0	--	56	9.2	84	2.5	83	13	204	0.3	0.2	427	178	110	849	7.7	5	6.2	5.2
Oct. 3	213	.6	--	--	--	87		82	13	187	--	.2	--	155	87	801	6.7	5	--	--
Oct. 8-9	267	4.0	--	--	--	117		88	17	247	--	.5	--	184	112	988	7.7	3	--	--
Oct. 1-10	--	--	0.33	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Oct. 11-20	205	1.4	.13	58	8.1	103	2.6	87	30	223	.1	.8	495	181	109	970	7.6	22	3.9	3.9
Oct. 21-31	218	4.5	.22	64	11	117	2.7	96	34	255	.1	.8	546	207	128	1060	7.9	12	4.9	3.4
Nov. 1, 2, & 10	283	--	--	--	--	133		95	38	256	--	1.5	--	190	112	989	7.3	--	--	--
Nov. 3-9	265	4.8	--	51	9.5	89	2.1	88	31	188	.1	1.5	445	167	95	802	7.7	9	3.4	3.3
Nov. 1-10	--	--	.17	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Nov. 11-15	447	5.6	--	55	12	119	2.6	77	37	255	.0	1.0	565	187	124	1000	7.5	13	5.2	3.0
Nov. 16-17	841	--	--	48	9.2	97		60	33	202	--	1.4	--	158	109	794	7.3	--	--	--
Nov. 18-20	728	--	--	37	7.7	73		57	30	144	--	.9	--	124	77	583	7.3	--	--	--
Nov. 11-20	--	--	.19	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Nov. 21-22	582	--	--	--	--	69		52	29	131	--	.7	--	107	65	539	7.0	--	--	--
Nov. 23-30	1580	4.7	--	25	5.2	40	2.5	36	31	82	.0	.7	227	84	54	387	6.8	12	4.8	2.6
Nov. 21-30	--	--	.25	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Dec. 1-5, 7	1010	4.6	--	31	5.2	51	1.4	48	26	105	.0	1.0	259	99	60	479	7.3	14	4.5	2.3
Dec. 6, 8-10	2130	4.1	--	24	4.8	34	1.9	35	24	78	.1	1.1	198	80	51	360	7.2	16	--	--
Dec. 1-10	--	--	.34	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Dec. 11-15, 17	2740	7.8	--	17	3.8	24	1.2	29	23	46	.0	.8	153	58	34	247	7.1	15	6.9	3.2
Dec. 16, 18-20	1520	5.6	--	23	4.6	27	1.7	37	20	62	.1	.9	182	77	47	318	7.2	18	--	--
Dec. 11-20	--	--	.23	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Dec. 23-26	4420	4.4	--	14	3.0	19	1.7	25	20	34	.1	.7	133	47	27	195	6.8	9	--	--
Dec. 21, 22, 27-31	2260	5.6	--	20	3.5	25	1.2	33	20	52	.0	.9	165	64	37	269	7.0	17	4.4	2.2
Dec. 21-31	--	--	.17	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Jan. 1-10, 1954	1180	4.6	.17	26	5.2	34	1.7	45	21	74	.1	1.1	210	86	50	374	7.2	12	2.7	2.1
Jan. 11-15	874	4.5	--	32	5.6	46	2.1	57	25	98	.2	1.3	264	104	57	468	7.3	9	3.2	1.7
Jan. 16-17, 19-20	845	5.0	--	--	--	55		59	24	110	--	1.0	--	110	62	508	7.4	--	--	--
Jan. 11-20	--	--	.14	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Jan. 21-26	3360	4.2	--	16	3.4	21	1.2	30	18	44	.1	.8	146	55	30	234	7.3	12	6.8	2.1
Jan. 27-31	7390	--	--	--	--	15		22	15	23	--	.7	--	34	16	146	7.0	--	--	--
Jan. 21-31	--	--	.26	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Feb. 1-6	2690	4.8	--	16	3.1	22	1.1	29	19	42	.1	1.0	134	53	29	221	7.1	16	--	--
Feb. 7-10	1500	--	--	24	4.1	33		40	19	70	--	1.0	203	77	44	332	7.1	--	--	--
Feb. 1-10	--	--	.18	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Feb. 11-14	1090	7.8	--	26	4.9	34		47	21	70	--	1.1	220	86	47	363	7.3	20	7.6	3.7
Feb. 15	2600	--	--	--	--	23		16	15	58	--	1.7	--	62	49	280	7.0	20	--	--
Feb. 16-20	8420	4.2	--	11	2.0	12	1.1	18	15	24	.2	1.1	90	36	22	147	7.0	20	--	--
Feb. 11-20	--	--	.14	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Feb. 22-25	6860	4.7	--	13	2.3	12	1.4	19	21	25	.3	.6	111	43	28	143	6.8	9	--	--
Feb. 21, 26-28	4480	4.5	--	14	2.6	16	1.1	24	19	32	.1	.5	155	47	27	180	7.0	12	--	--
Feb. 21-28	--	--	.17	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

OHIO RIVER MAIN STEM—Continued

Table 2. - ALLEGHENY RIVER AT RED HOUSE, N. Y.—Continued

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Chemical analyses, in parts per million, water year October 1953 to September 1954—Continued

Date of collection	Mean discharge (cfs)	Silica (SiO_2)	Iron (Fe)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Dissolved solids (residue on evaporation at 180°C)	Hardness as $CaCO_3$ Total	Hardness as $CaCO_3$ Non-carbonate	Specific conductance (micromhos at 25°C)	pH	Color	Oxygen consumed Unfiltered	Oxygen consumed Filtered
Mar. 2-5, 1954	12900	—	—	—	—	8.4		13	15	14	—	0.6	—	28	18	109	6.9	—	—	—
Mar. 6-7	5660	—	—	—	—	14		20	18	24	—	.5	—	39	23	154	7.0	—	—	—
Mar. 1, 8-10	3800	5.4	—	15	2.7	17	1.0	27	17	34	0.1	.3	118	49	27	197	7.3	13	13	3.1
Mar. 1-10	—	—	.20	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Mar. 11-20	2480	4.4	.17	16	3.0	21	1.2	34	18	40	.1	.6	128	53	25	226	7.3	10	5.3	4.5
Mar. 21-25	2840	3.5	—	16	3.3	19	1.0	30	16	38	.1	.7	129	54	29	201	7.3	16	5.6	2.5
Mar. 26-31	5710	3.7	—	13	2.9	13	1.0	22	16	27	.1	.7	101	44	26	156	7.0	12	5.6	2.8
Mar. 21-31	—	—	.15	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Apr. 1-5	3840	5.4	—	14	3.2	15	.5	27	17	31	.0	.6	126	49	27	189	7.5	9	3.3	2.1
Apr. 6-10	6990	4.1	—	12	2.5	11	.5	22	16	24	.0	.7	103	42	24	151	7.2	12	4.8	2.9
Apr. 1-10	—	—	.10	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Apr. 11,12,18,19,20	8280	4.2	—	11	2.6	9.5	.8	19	16	19	.0	1.0	82	38	23	127	7.1	15	7.7	3.7
Apr. 13-17	5730	5.0	—	13	3.2	13	1.1	24	18	29	.0	1.0	110	46	26	170	7.0	12	6.3	3.3
Apr. 11-20	—	—	.23	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Apr. 21-24, 28-30	7720	6.9	—	11	1.9	11	1.1	22	15	20	.1	1.2	91	35	17	139	6.6	10	7.3	4.2
Apr. 25, 26, 27	4230	—	—	—	—	19		29	14	34	—	1.0	—	46	22	196	6.9	7	—	—
Apr. 21-30	—	—	.13	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
May 1-10	6520	6.3	.15	12	2.2	13	1.1	25	13	24	.1	1.0	94	39	18	148	6.8	5	5.3	3.2
May 11-15	3540	6.7	—	15	2.6	17	1.0	32	13	32	.1	.8	111	48	22	189	7.0	6	4.4	3.4
May 16, 17, 18	1990	—	—	—	—	23		40	14	38	—	.6	—	52	18	228	7.3	5	—	—
May 19, 20	1530	—	—	—	—	28		45	14	51	—	.6	—	62	25	282	7.3	5	—	—
May 11-20	—	—	.08	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
May 21-25, 31	1170	7.6	—	25	4.5	34	1.3	53	17	69	.1	.6	215	81	37	351	7.2	7	4.0	3.0
May 26-30	1020	4.7	—	28	5.1	41	1.3	61	21	80	.1	.5	245	91	41	408	7.2	8	5.6	3.4
May 21-30	—	—	.10	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
June 1,3,4,9,10	2060	7.9	—	19	3.3	25	1.2	39	15	51	.1	.8	166	61	29	272	6.9	12	12	5.8
June 2	1790	—	—	—	—	54		49	21	102	—	.4	—	89	49	471	7.0	7	—	—
June 5,6,7,8	2860	6.4	—	15	2.5	17	.8	32	14	33	.1	.8	117	48	22	198	7.1	5	12	1.4
June 1-10	—	—	.09	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
June 11-15	1430	5.4	—	22	4.0	28	1.1	48	14	57	.1	.6	178	71	32	302	7.3	5	4.3	4.3
June 16-20	964	4.9	—	27	5.0	38	1.6	55	18	80	.2	.5	237	90	44	394	7.1	10	6.6	4.4
June 11-20	—	—	.21	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
June 21-29	713	4.7	—	31	4.9	45	2.0	62	15	94	.0	1.5	267	99	48	453	7.1	10	3.7	2.4
June 30	442	—	—	—	—	60		75	17	118	—	1.0	—	116	55	558	7.5	5	—	—
June 21-30	—	—	.34	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
July 1-8, 10	403	4.0	—	43	4.7	66	2.1	78	17	136	.0	1.0	365	127	63	623	7.4	5	14	2.4
July 9	415	—	—	—	—	90		78	22	192	—	1.0	—	162	98	831	7.2	5	—	—
July 1-10	—	—	.22	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
July 11-16, 18-20	300	4.0	—	45	4.7	74	2.1	81	21	150	.1	.9	394	132	66	675	7.5	5	3.4	3.0
July 17	331	—	—	—	—	94		84	26	184	—	1.5	—	152	83	795	7.4	5	—	—
July 11-20	—	—	.17	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
July 21-30	218	4.7	—	49	8.8	86	2.2	90	29	176	.1	1.8	467	159	86	782	7.5	5	6.6	2.6
July 31	263	—	—	—	—	99		87	30	199	—	1.0	—	168	97	855	7.4	5	—	—
July 21-31	—	—	.18	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

OHIO RIVER MAIN STEM—Continued

Table 2. - ALLEGHANY RIVER AT RED HOUSE, N. Y.—Continued

9-268f

Chemical analyses, in parts per million, water year October 1953 to September 1954—Continued

Date of collection	Mean discharge (cfs)	Silica (SiO_2)	Iron (Fe)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Dissolved solids (residue on evaporation at 180°C)	Hardness as $CaCO_3$ Total	Hardness as $CaCO_3$ Non-carbonate	Specific conductance (micromhos at 25°C)	pH	Color	Oxygen consumed Unfiltered	Oxygen consumed Filtered
Aug. 1	285	—	—	—	—	130		90	34	270	—	1.0	—	207	133	1110	7.0	5	—	—
Aug. 2, 4	282	--	—	—	--	89		80	26	171	—	1.5	—	142	76	753	7.3	5	—	—
Aug. 3, 5-10	219	5.9	—	53	11	98	2.4	98	30	209	0.1	1.5	528	179	107	894	7.3	5	4.4	3.9
Aug. 1-10	—	—	.14	—	—	—	--	—	--	—	—	—	—	—	—	—	—	—	—	—
Aug. 13, 14, 20	193	—	—	—	—	129		98	34	249	—	3.0	—	188	108	1040	7.5	5	—	—
Aug. 11, 12, 15-19	195	5.0	—	55	11	107	2.5	95	33	218	.1	1.4	545	183	105	916	7.5	5	4.8	2.7
Aug. 11-20	—	—	.36	—	—	--	—	--	—	—	—	—	—	—	—	—	—	—	—	—
Aug. 21-25	186	38	—	60	12	112	2.6	96	33	236	.1	2.5	582	200	121	997	7.3	5	4.9	3.8
Aug. 26	340	--	—	—	--	189		84	54	380	—	7.0	—	256	187	1480	7.0	10	—	—
Aug. 27-31	285	4.0	—	52	7.4	100	2.7	80	31	204	.1	1.5	512	161	95	857	7.3	7	5.0	4.0
Aug. 21-31	—	—	.15	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Sept. 1, 4-10	173	4.7	—	57	11	108	2.6	90	32	227	.1	1.0	568	188	115	941	7.6	7	4.5	3.6
Sept. 2, 3	242	—	--	—	—	162		89	42	319	—	1.6	—	216	143	1270	7.5	5	—	—
Sept. 1-10	—	—	.12	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Sept. 11-13,15-17,19	182	5.4	—	63	10	121	2.8	98	36	252	.1	1.4	606	200	120	1050	7.5	5	5.0	3.9
Sept. 14-18	193	—	—	—	—	157		103	44	315	—	1.5	—	234	150	1280	7.5	5	—	—
Sept. 20	215	—	—	—	—	108		86	32	218	—	1.0	—	176	106	929	7.4	5	—	—
Sept. 11-20	—	—	.16	—	—	—	--	—	—	--	—	—	—	--	—	—	—	—	—	—
Sept. 21-24, 28-30	257	4.3	—	63	9.8	126	2.8	88	37	262	.1	1.0	624	198	126	1060	7.7	5	5.0	3.9
Sept. 25, 26, 27	249	—	—	—	—	97		82	30	195	—	1.0	—	164	97	835	7.7	5	—	—
Sept. 21-30	—	—	.15	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Average ----	2140	5.5	0.19	31	5.5	48.5	1.7	56	23	123	0.09	1.1	268	111	65	543	--	9	5.8	3.2

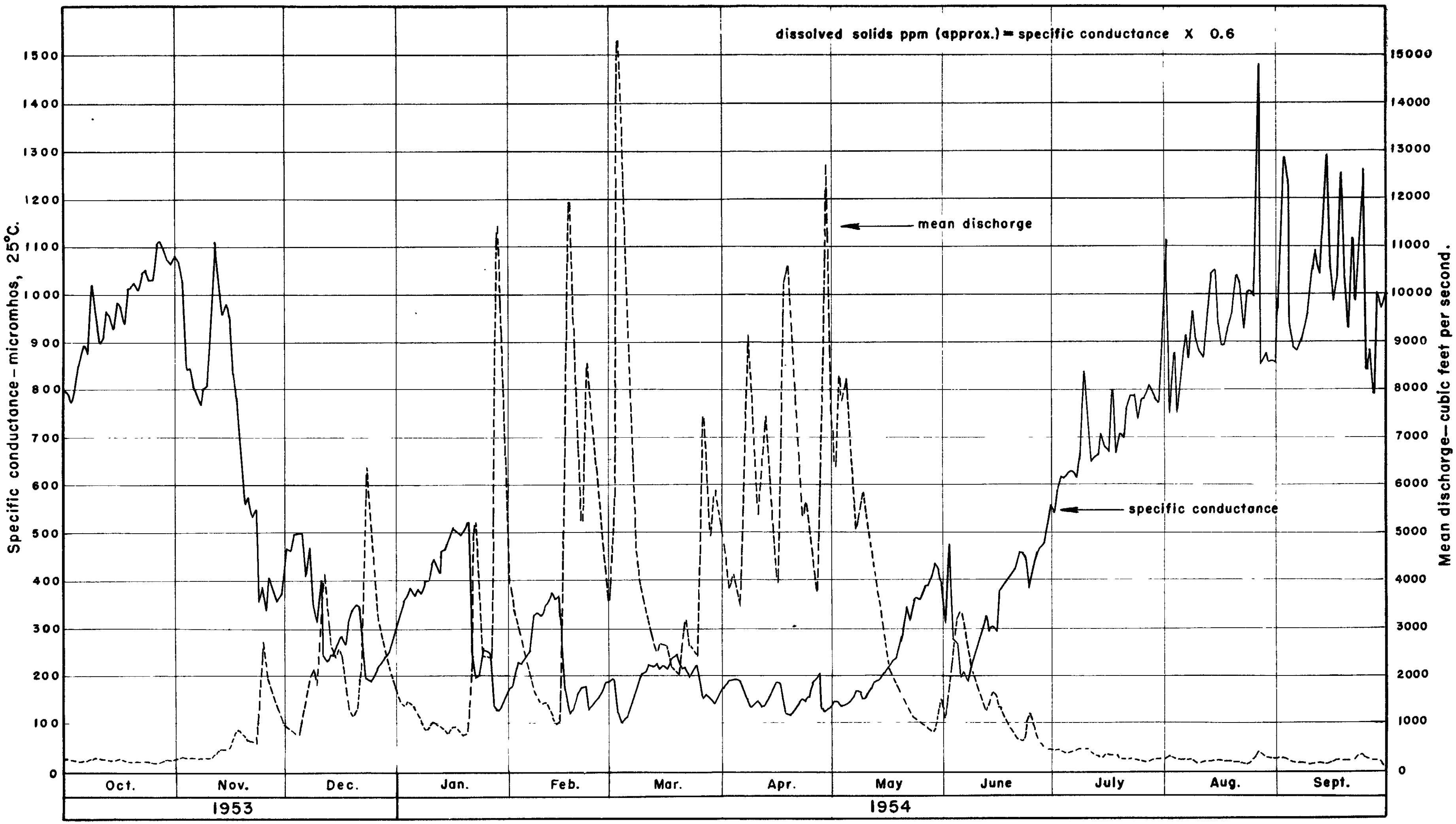

Figure 2. Fluctuation of specific conductance and mean discharge of Allegheny River at Red House, New York.

determine the trend throughout the year. Here, too, there was considerable fluctuation with discharge. The chloride range extended from 12 to 324 ppm (table 3).

Daily chloride concentrations during the period October 1953 to September 1954 are plotted in fig. 3. The upper range is especially significant because the utility of the water from the Allegheny River would be affected to some extent. A concentration of chloride exceeding 250 ppm is not recommended in a source of public water supply. Even at concentrations less than 250 ppm, a salty taste might be imparted to the water. Generally, the higher concentrations of chloride in water would not impair its utility industrially or agriculturally.

During the same period, other anions were present in moderate amounts. Ranges for other anions are given below.

Constituent	Range (ppm)
Bicarbonate (HCO_3)	13 - 103
Sulfate (SO_4)	13 - 54
Fluoride (F)	0.0 - 0.3
Nitrate (NO_3)	0.2 - 7.0

Generally, these concentrations of the anions shown above would not affect the utility of the water from the Allegheny River for industrial and agricultural purposes. As a source of public water supply, of course, other factors would have to be considered.

Of the cations, concentrations of sodium predominated. They ranged from a low 9.6 to a high of 126 ppm. On the other hand, there was very little variation in the concentrations of potassium. The maximum determined was 2.8 ppm and the minimum was 0.5 ppm.

Table 3. - DAILY CHLORIDE CONCENTRATIONS, ALLEGHENY RIVER AT RED HOUSE, N. Y.

9-267 b

Chloride concentrations, parts per million, water year October 1953 to September 1954

Day	October	November	December	January	February	March	April	May	June	July	August	September
1	187	280	105	62	30	33	28	19	59	112	270	232
2	182	246	110	71	40	16	33	21	103	125	165	324
3	187	187	106	72	42	12	34	18	54	134	210	311
4	204	196	111	78	42	13	34	20	52	134	170	218
5	209	184	97	77	45	16	31	21	33	135	195	209
6	215	174	82	77	50	22	29	22	38	138	218	210
7	211	180	98	78	68	26	26	27	29	132	202	215
8	254	189	76	76	68	30	22	26	35	146	230	218
9	237	197	73	71	68	34	22	22	46	192	213	224
10	220	243	83	86	74	34	24	22	52	158	205	248
11	202	287	49	95	71	38	-	29	57	145	212	268
12	220	259	43	92	75	37	-	29	65	140	218	252
13	215	236	45	100	65	38	-	31	54	145	248	266
14	208	250	45	102	69	34	-	32	58	155	250	315
15	222	234	46	110	58	36	-	33	55	148	219	248
16	218	209	55	110	26	35	-	36	75	145	206	239
17	218	192	55	115	17	40	-	39	76	184	205	242
18	238	160	63	112	18	41	-	39	77	141	218	308
19	240	134	64	115	23	43	-	48	80	155	226	244
20	242	137	68	118	27	35	-	56	89	155	250	218
21	245	132	71	46	31	43	20	66	88	168	245	270
22	255	131	66	37	21	36	22	59	92	179	220	251
23	255	70	35	35	22	40	22	70	88	175	240	273
24	250	84	32	53	26	40	23	72	74	165	240	316
25	252	72	38	47	29	33	31	68	90	172	238	202
26	265	94	31	45	28	29	30	76	90	172	380	199
27	272	87	35	21	33	27	36	75	92	182	205	175
28	262	78	38	19	32	29	18	82	92	179	210	234
29	255	81	42	20	—	22	14	89	108	172	202	229
30	245	93	53	27	—	28	19	88	118	171	205	244
31	250		59	30	—	28	—	78	—	199	202	—
Average	230	170	64	71	43	31	26	46	71	157	223	247

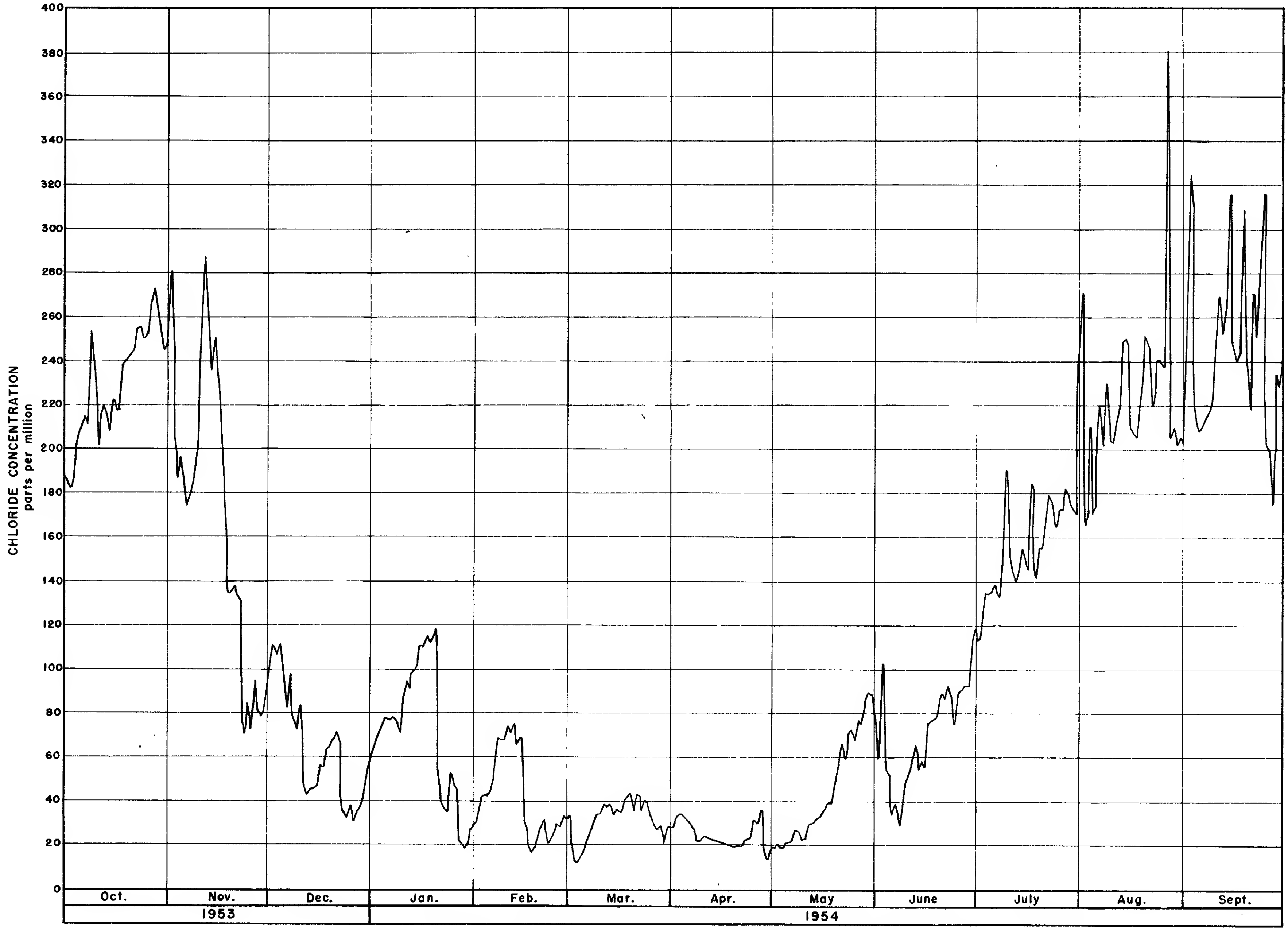

FIGURE 3. CHLORIDE CONCENTRATIONS, ALLEGHENY RIVER AT RED HOUSE, NEW YORK

Iron, as was mentioned earlier, if present in concentrations exceeding 0.3 ppm will precipitate. This condition would be unsatisfactory if a water were used for industrial or public water supply purposes. Iron concentrations in water samples from the Allegheny River during 1953-1954 exceeded 0.3 ppm four times:

	ppm
October 1-10, 1953	0.33
December 1-10, 1953	0.34
June 21-30, 1954	0.34
August 11-20, 1954	0.36

Hardness varied considerably throughout the year, and was caused primarily by the concentrations of calcium and to a lesser extent by magnesium. During low flow, the ratio of calcium to magnesium was 6.1 and during the high flow 5.1. Fluctuations in hardness during 1953-1954 are shown in fig. 4.

Water temperature of the Allegheny River followed a seasonal pattern. Temperatures fluctuated below the average of 54°F in November 1953 until a minimum of 31°F was reached on December 19, 1953. There were several small rises, but these did not last very long. Generally, the water temperature remained well below the average throughout the period November 1953 to April 1954. Gradual rises in temperature took place towards the end of April and continued upward until a maximum of 80°F was reached on July 14, 1954. Fluctuations in water temperature are shown in fig. 5.

Generally, on the basis of mineral content, the chemical quality of water from the Allegheny River at Red House was satisfactory during the period December 1953 to May 1954. At other times throughout the year, when chloride and iron concentrations exceeded recommended limits, and when the water was hard, the water could be improved with proper treatment.

CHEMUNG RIVER AT CHEMUNG, NEW YORK

Chemung River is formed just west of Corning, New York by the confluence of the Cohocton River flowing from the northwest and the Tioga River flowing from the south. Flowing in a southeasterly direction, it crosses the Pennsylvania-New York State line several times and finally joins the Susquehanna River south of Sayre, Pennsylvania.

The river valley is broad and generally level. It is about 800 feet above mean sea level and is surrounded on all sides by hills varying in elevation from 900 to 1,800 feet above sea level. For the most part, these slope gently to the river valley. Only in a few places do hills rise abruptly from the river's edge. Many small tributaries have their origin in the surrounding hills, flow into the valley and join the main stem.

At Chemung, New York, Chemung River has a drainage area of approximately 2,530 square miles. Its chemical quality is a composite of the Cohocton, Tioga, and Canisteo Rivers and many smaller tributaries. A daily sample of water was collected at this location during October 1953 to September 1954 in order to define the chemical quality of river water. Chemical analyses of composite samples for periods shown are given in table 5.

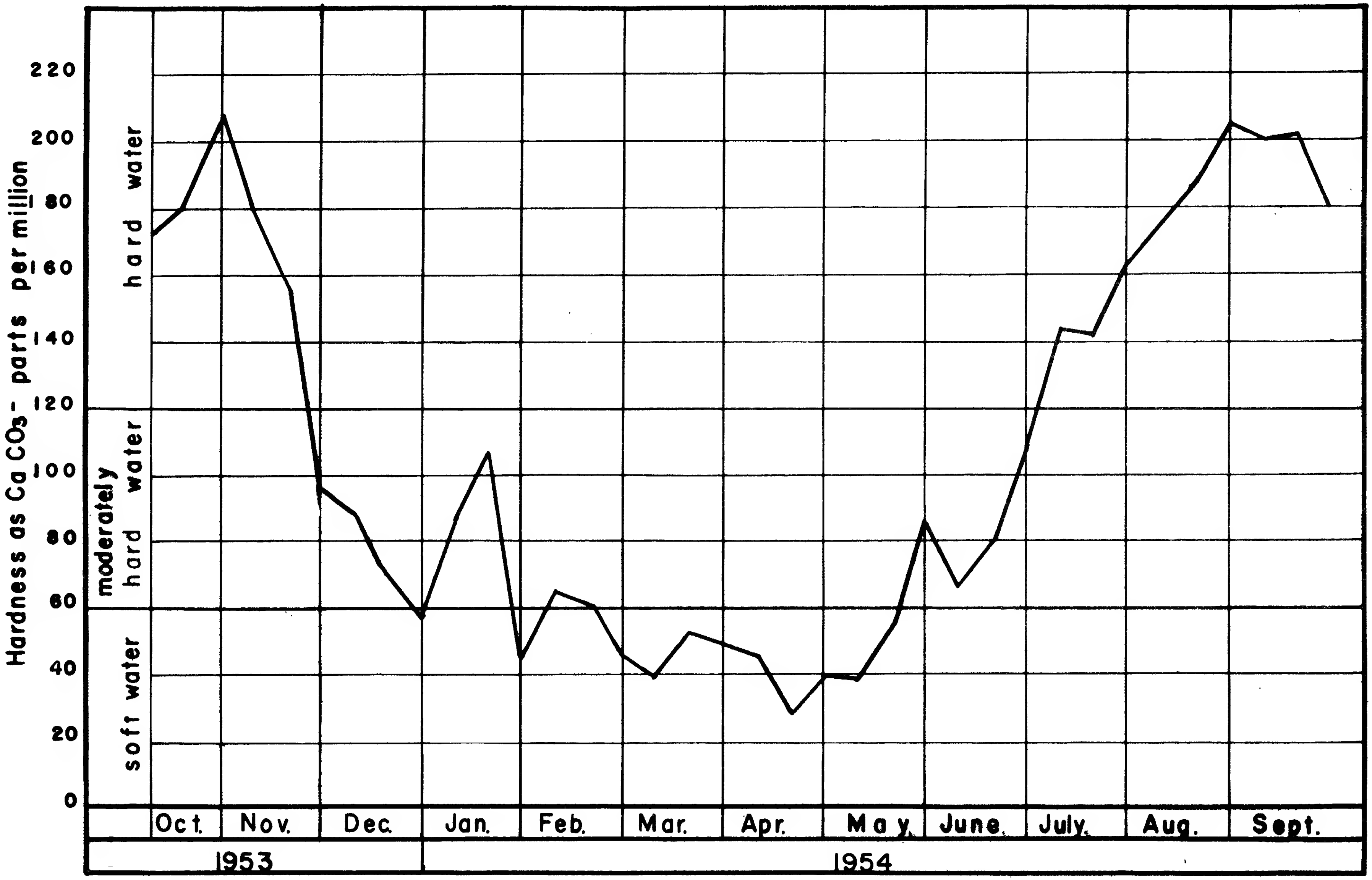

Figure 4. Hardness as $CaCO_3$ for periods shown
Allegheny River at Red House, N.Y.

Table 4. - DAILY WATER TEMPERATURES, ALLEGHENY RIVER AT RED HOUSE, N. Y.

9-267 b

Temperature (°F) of water, water year October 1953 to September 1954
(Once-daily temperature measurement at approximately 5 PM)

Day	October	November	December	January	February	March	April	May	June	July	August	September
1	65	51	39	33	33	44	40	60	67	78	77	71
2	64	54	39	34	34	45	-	62	64	80	76	71
3	65	53	39	34	35	41	39	60	64	76	75	72
4	61	46	41	34	35	35	41	55	64	78	75	72
5	58	44	42	35	35	34	43	52	57	76	75	73
6	54	42	42	34	34	34	45	50	59	75	76	75
7	52	36	42	33	34	34	46	50	63	73	76	76
8	53	36	42	33	33	33	49	50	66	70	74	74
9	54	34	40	35	34	34	51	50	69	73	75	73
10	55	42	40	33	35	34	52	51	71	73	73	73
11	55	42	39	33	34	38	51	50	75	75	73	66
12	55	42	40	33	33	40	47	50	77	77	72	70
13	55	42	40	32	32	40	49	52	77	78	71	67
14	56	43	39	32	34	39	51	55	78	80	71	63
15	56	46	35	33	35	36	52	59	77	78	70	62
16	58	46	34	33	38	37	51	60	75	78	71	61
17	59	46	34	32	38	39	50	62	70	78	71	62
18	59	46	32	32	39	39	52	58	72	75	71	63
19	59	46	31	33	38	40	54	59	75	78	-	65
20	60	45	33	33	38	39	55	60	77	78	71	63
21	60	47	34	33	42	39	58	60	78	78	71	60
22	59	49	35	33	41	40	60	62	79	76	71	60
23	59	48	33	33	41	40	58	62	76	75	73	58
24	55	47	32	34	40	41	59	62	75	76	-	60
25	54	45	32	35	40	43	58	64	77	76	76	61
26	55	41	32	35	40	43	57	64	75	78	72	60
27	-	41	33	35	40	44	57	65	78	78	72	60
28	54	39	33	34	43	44	55	65	73	77	72	67
29	53	38	35	33	-	43	56	64	75	75	72	65
30	54	38	36	33	-	41	57	67	75	79	-	70
31	53	-	34	33	-	40	-	69	-	79	-	-
Average	57	44	37	33	37	39	51	58	72	77	73	66

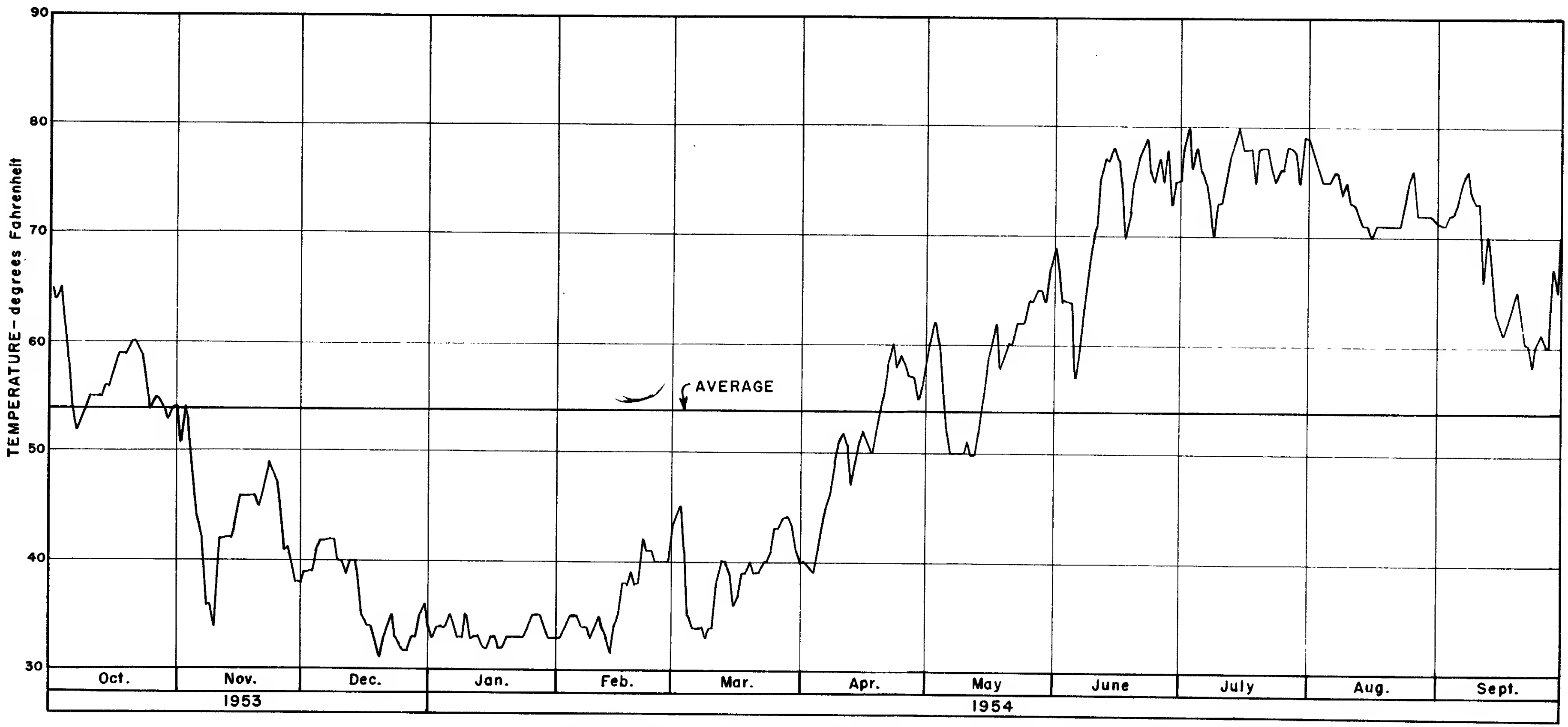

FIGURE 5. TEMPERATURE, ALLEGHENY RIVER AT RED HOUSE, NEW YORK

Throughout the year, the range of concentrations of dissolved solids was from 97 to 316 ppm with an average of 206 ppm. The changes in concentrations reflected fluctuations in discharges. During the periods of summer and early fall, river discharges were low, and concentrations of dissolved solids were comparatively higher than during the winter months when high discharges occurred. Daily specific conductances as well as mean daily discharge data are plotted in fig. 6. During periods of rapidly changing discharges, changes in concentrations lagged behind and were not as pronounced as during periods of gradual rise or fall in discharge.

The varying concentrations of dissolved solids reflected changes primarily in concentrations of calcium, magnesium, and to a lesser extent, sodium. The concentrations of the anions of bicarbonate, sulfate, and chloride also changed. On the other hand, potassium, silica, fluoride, and nitrates were present in smaller and fairly uniform quantities in all samples analyzed throughout the year.

The ranges for the constituents, shown in the heading of table 5 are given below:

Constituent	Range (ppm)
Silica (SiO_2)	1.0 - 9.8
Iron (Fe)	0.02 - 0.53
Calcium (Ca)	17 - 53
Magnesium (Mg)	2.2 - 12
Sodium (Na)	5.9 - 58
Potassium (K)	0.9 - 3.0
Bicarbonate (HCO_3)	25 - 158
Sulfate (SO_4)	21 - 62
Chloride (Cl)	7.1 - 92
Fluoride (F)	0.0 - 0.3
Nitrate (NO_3)	0.6 - 14
Dissolved solids	97 - 316
Total hardness	52 - 182

Table 5. - CHEMUNG RIVER AT CHEMUNG, N. Y.

LOCATION.--At gaging station at highway bridge, three-quarters of a mile southwest of Chemung, Chemung County and 10 miles upstream from mouth.
DRAINAGE AREA.--2,530 square miles.
RECORDS AVAILABLE.--Chemical analyses: October 1953 to September 1954.
Water temperatures: October 1953 to September 1954.
EXTREMES, 1953-1954.--Dissolved solids: Maximum, 316 ppm Aug. 1-10; minimum, 97 ppm May 11-17.
Total hardness: Maximum, 182 ppm Nov. 1-10; minimum, 52 ppm Apr. 18-20, May 3-7, June 3, 4, 5.
Specific conductance: Maximum, 586 micromhos May 28; minimum, 127 micromhos Mar. 3.
Water temperature: Maximum, 78°F June 23, Aug. 1; minimum, 32°F Jan. 10-11, 23, 28, 29, 31, Feb. 13.
REMARKS.--Records of specific conductance of daily samples from October 1953 to September 1954 available in Quality of Water Branch district office, Albany, N. Y. Records of discharge for water year October 1953 to September 1954 available in Surface Water Branch district office, Albany, N. Y.

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Chemical analyses, in parts per million, water year October 1953 to September 1954

Date of collection	Mean discharge (cfs)	Silica (SiO_2)	Iron (Fe)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Dissolved solids (residue on evaporation at 180°C)	Hardness as $CaCO_3$ Total	Hardness as $CaCO_3$ Non-carbonate	Specific conductance (micromhos at 25°C)	pH	Color	Oxygen consumed Unfiltered	Oxygen consumed Filtered
Oct. 1-10, 1953	170	2.5	0.19	52	11	14	2.8	151	50	23	0.1	2.1	253	176	52	406	7.8	7	3.8	3.6
Oct. 11-20	172	2.2	.10	50	12	16	3.0	142	62	23	.1	2.6	242	176	60	415	7.9	8	4.5	2.4
Oct. 21-31	169	1.0	.51	51	12	18	2.7	154	47	31	.1	3.1	248	179	53	427	7.8	12	3.2	2.2
Nov. 1-10	171	2.5	.16	53	12	19	2.2	158	56	26	.1	1.9	255	182	53	429	7.7	8	2.3	1.5
Nov. 11-20	312	1.3	.12	49	12	18	2.2	142	57	28	.1	1.4	242	173	56	409	7.6	16	2.1	1.4
Nov. 21-24	735	1.0	—	43	9.5	15	2.6	121	55	19	.1	1.1	228	148	49	354	7.3	15	—	—
Nov. 25-30	710	5.1	—	29	6.3	8.1	2.6	70	42	13	.1	.9	154	99	42	243	7.0	14	6.5	2.2
Nov. 21-30	—	—	.15	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Dec. 1-10	549	3.6	.13	37	8.2	11	1.7	87	62	14	.0	1.6	176	127	55	294	7.5	14	2.4	1.6
Dec. 11-20	890	2.9	.27	30	6.2	11	1.8	74	46	11	.1	1.3	153	101	40	241	7.2	13	2.7	1.5
Dec. 21-31	870	2.8	.18	31	6.7	11	1.6	81	48	12	.0	1.4	159	106	39	252	7.6	12	2.5	1.4
Jan. 1-10, 1954	458	2.5	.11	37	8.0	13	1.9	99	50	16	.0	1.5	173	126	45	293	7.6	8	2.3	1.4
Jan. 11-20	325	2.8	.09	46	9.5	16	2.5	127	57	20	.2	2.4	220	154	50	364	7.6	10	2.0	1.5
Jan. 21-24	1140	3.8	—	41	7.0	16	2.0	112	51	19	.1	2.3	218	132	40	344	7.6	19	8.4	2.0
Jan. 25-27	1200	—	—	—	—	10		84	35	13	—	1.9	—	103	34	251	7.5	—	—	—
Jan. 28-31	2920	—	—	—	—	6.3		53	29	7.1	—	1.8	—	71	28	176	7.3	—	—	—
Jan. 21-31	—	—	.53	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Feb. 1-10	897	9.8	.12	30	6.2	7.6	1.6	76	36	12	.1	1.9	147	101	38	239	7.3	15	—	—
Feb. 11-16	725	3.8	—	36	7.6	11	1.6	96	39	16	.1	3.8	173	122	43	292	7.7	20	10	3.6
Feb. 17-20	6030	3.8	—	21	3.3	9.5	2.2	51	24	14	.2	3.2	115	67	25	166	7.5	20	—	—
Feb. 11-20	—	—	.14	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Feb. 21-28	4800	4.8	.21	19	3.3	7.2	1.7	40	29	13	.1	1.3	118	61	28	167	7.1	15	24	3.0
Mar. 1-2, 6-10	7030	5.2	—	21	4.3	9.6	2.0	43	34	16	.2	1.0	134	71	36	195	7.4	16	23	6.5
Mar. 3-5	9490	—	—	—	—	6.6		33	27	8.3	—	1.0	—	53	26	144	7.4	—	—	—
Mar. 1-10	—	—	.45	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Mar. 11-20	2010	4.5	.13	24	4.5	18	1.1	66	29	26	.1	1.8	144	79	25	252	7.4	15	5.1	3.5
Mar. 21-26	2060	3.7	—	26	5.4	19	1.6	62	35	29	.1	1.6	166	87	36	266	7.3	14	4.0	2.8
Mar. 27-31	3290	—	—	—	—	19		49	33	20	—	1.5	—	63	23	201	7.4	—	—	—
Mar. 21-31	—	—	.08	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Apr. 1-2, 4-7, 10	3770	3.1	—	20	4.0	12	.9	50	28	18	.0	1.6	124	68	27	183	7.4	7	3.2	2.5
Apr. 3	3570	—	—	—	—	16		42	30	30	—	1.0	—	68	40	234	6.9	—	—	—
Apr. 8, 9	5180	—	—	—	—	8.0		40	27	11	—	1.4	—	60	27	165	7.4	—	—	—
Apr. 1-10	—	—	.06	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Apr. 11-17	3290	3.3	—	22	4.9	15	1.4	54	31	22	.0	1.0	134	75	31	221	7.5	7	3.5	2.1
Apr. 18-20	7690	—	—	—	—	8.9		36	27	9.2	—	1.2	—	52	23	147	7.5	—	—	—
Apr. 11-20	—	—	.21	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Apr. 23-28	5470	3.9	—	20	2.9	14	1.5	50	26	22	.2	1.1	124	62	21	205	7.4	2	3.9	2.5
Apr. 21, 22, 30	5300	—	—	—	—	9.2		45	24	12	—	1.7	—	60	23	170	7.5	—	—	—
Apr. 29	1080	—	—	—	—	5.3		25	22	7.0	—	14	—	53	32	145	6.7	—	—	—
Apr. 21-30	—	—	.17	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Table 5. - CHEMUNG RIVER AT CHEMUNG, N. Y.—Continued

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Chemical analyses, in parts per million, water year October 1953 to September 1954—Continued

Date of collection	Mean discharge (cfs)	Silica (SiO_2)	Iron (Fe)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Dissolved solids (residue on evaporation at 180°C)	Hardness as $CaCO_3$: Total	Hardness as $CaCO_3$: Non-carbonate	Specific conductance (micromhos at 25°C)	pH	Color	Oxygen consumed: Unfiltered	Oxygen consumed: Filtered
May 1, 2, 8-10	6990	5.5		19	2.3	11	1.3	47	24	15	0.2	1.0	115	58	19	182	7.6	5	6.9	2.6
May 3-7	12700	5.9	—	17	2.2	5.9	1.5	40	22	8.8	.2	1.4	97	52	19	146	7.4	10	2.9	3.6
May 1-10	—	—	0.24	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
May 11-17	3110	4.3	—	24	3.8	20	1.3	64	29	29	.2	1.0	152	76	24	254	7.8	2	2.9	2.4
May 18-20	1530	—	—	—	—	33		86	32	47	—	.6	—	99	29	353	7.7	—	—	—
May 11-20	—	—	.11	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
May 21-24	1110	1.8	—	33	5.8	44	1.6	92	36	68	.1	.8	256	106	31	432	7.8	1	2.6	2.5
May 25-30	1020	1.3	—	37	6.7	58	1.7	102	51	91	.1	1.0	306	120	37	529	7.7	1	3.8	2.7
May 31	1840	—	—	—	—	16		71	30	26	—	.6	—	92	34	292	7.7	—	—	—
May 21-31	—	—	.09	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
June 2	13900	—	—	—	—	16		86	27	23	—	.8	—	96	25	275	6.8	6	—	—
June 3, 4, 5	5790	—	—	—	—	11		49	21	10	—	1.0	—	52	12	164	7.2	5	—	—
June 1, 6-10	2010	6.2	—	24	5.4	10	1.5	73	25	14	.1	.8	140	82	22	219	7.5	8	4.9	4.4
June 1-10	—	—	.10	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
June 11-14, 16-17	1180	9.9	—	31	6.6	23	2.0	92	35	37	.2	1.0	198	104	29	327	7.3	8	4.6	3.3
June 15, 18, 20	920	—	—	—	—	34		98	30	50	—	.8	—	108	29	387	7.4	7	—	—
June 19	753	—	—	—	—	37		103	29	56	—	.6	—	114	30	419	7.4	8	—	—
June 11-20	—	—	.02	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
June 23	557	—	—	—	—	29		113	40	38	—	1.0	—	124	32	368	7.6	—	—	—
June 25,26,28,29	568	—	—	—	—	43		118	42	61	—	1.1	—	134	37	451	7.5	—	—	—
June 21,22,24,27,30	551	2.3	—	37	8.8	32	2.2	118	40	51	.0	.8	258	129	32	407	7.5	16	3.8	3.1
June 21-30	—	—	.40	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
July 1-3	363	—	—	—	—	37		126	41	55	—	1.5	—	144	41	443	7.5	—	—	—
July 6-7	350	—	—	—	—	64		128	49	92	—	.9	—	148	43	541	7.4	—	—	—
July 4, 5, 8-10	332	2.1	—	42	8.1	45	2.2	128	40	70	.1	1.0	307	139	34	499	7.5	16	3.4	3.2
July 1-10	—	—	.06	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
July 12-15	235	—	—	—	—	43		136	47	60	—	2.6	—	154	43	489	7.0	7	—	—
July 11, 16	240	—	—	—	—	40		144	44	50	—	2.5	—	149	31	455	7.0	5	—	—
July 17-20	220	1.9	—	47	9.2	24	2.6	142	43	38	.1	2.5	258	156	39	420	7.2	20	1.9	1.5
July 11-20	—	—	.04	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
July 21-24	186	—	—	—	—	32		138	45	46	—	2.6	—	158	45	459	7.1	10	—	—
July 25-31	176	2.0	—	48	8.9	41	2.6	144	43	62	.1	2.3	310	158	40	513	7.0	5	2.0	1.7
July 21-31	—	—	.04	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Aug. 1-10	183	1.8	.03	47	8.7	41	2.6	141	46	62	.1	2.5	316	154	38	514	7.6	7	1.9	1.8
Aug. 11-20	152	1.7	.04	48	10	38	1.4	137	60	54	.2	1.4	280	161	49	496	7.3	13	—	—
Aug. 21-31	122	1.5	.06	48	11	36	1.7	143	54	56	.2	1.5	288	167	50	500	7.5	13	—	—
Sept. 1-10	111	1.9	.05	48	8.5	38	1.8	143	52	50	.2	1.4	280	156	39	496	7.5	12	—	—
Sept. 11-20	126	1.2	.08	50	10	32	1.8	147	59	43	.3	2.0	280	166	46	495	7.8	15	—	—
Sept. 21-30	138	1.8	.06	49	11	35	1.8	142	60	52	.1	1.8	283	169	52	501	7.6	15	—	—
Average -----	2260	3.3	.15	36	7.3	21	1.9	93	39	32	1.2	1.7	206	113	36	328	—	11	5.0	2.6

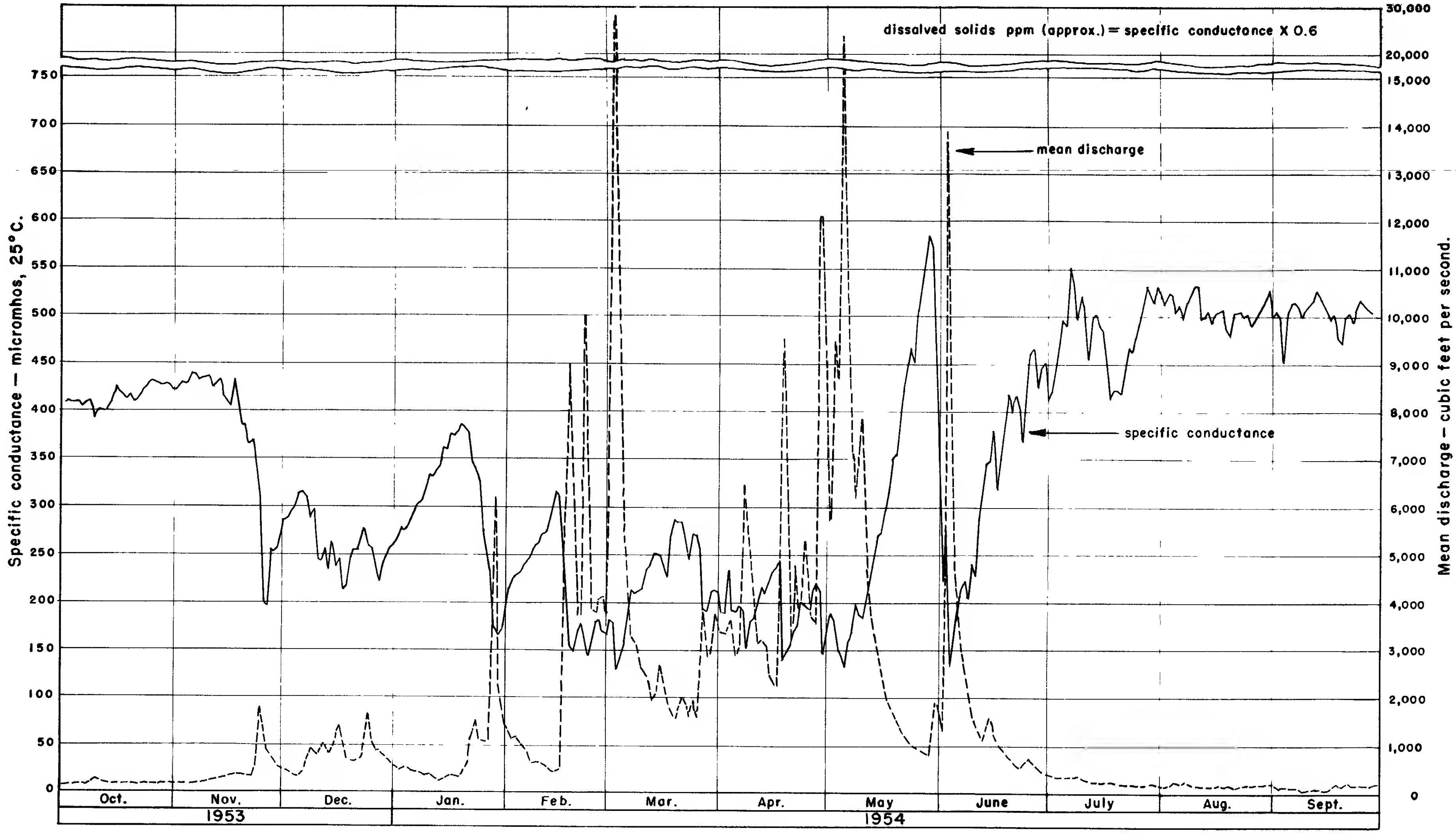

FIGURE 6. Fluctuation of specific conductance and mean discharge of Chemung River at Chemung, New York.

The water temperature of the Chemung River formed a complete cycle about the average throughout the period October 1953 to September 1954. The average for the year was 52°F. Starting early in November 1953, water temperatures dropped erratically below the average until the freezing point of water was reached. During January, February and early March temperatures hovered about the freezing point. With the spring thaw a gradual rise in water temperature took place. Temperatures then remained above the average throughout late spring, summer and fall, reaching a maximum of 78°F on June 23, 1954. It will be noted in figure 8 that water temperatures, with only few exceptions, were below 65°F for almost eight months of the year.

Generally, on the basis of mineral content, the chemical quality of the water from Chemung River was good. The concentrations of mineral matter did not exceed recommended concentrations established by the U. S. Public Health Service for inter-state carriers and generally accepted as standards for public water supplies. During periods of low flow, increased concentrations of calcium and magnesium increased the hardness of the water (fig. 7). Iron occurred in appreciable quantities four times throughout the year and, at such times, would be troublesome. However, with suitable treatment, hardness and iron concentrations can be reduced.

Table 6. - DAILY WATER TEMPERATURES, CHEMUNG RIVER AT CHEMUNG, N. Y.

9-267 b

Temperature (^{o}F) of water, water year October 1953 to September 1954
(Once-daily temperature measurement at approximately 7:30 A.M.

Day	October	November	December	January	February	March	April	May	June	July	August	September
1	64	51	41	34	33	44	38	53	68	72	78	66
2	63	52	40	34	33	41	39	60	69	73	74	66
3	61	52	40	34	33	38	39	63	60	75	74	69
4	62	51	41	34	33	34	32	58	62	71	71	69
5	62	48	44	34	34	33	38	54	62	72	71	71
6	60	44	43	34	34	34	44	53	58	70	71	72
7	54	38	44	34	34	33	47	51	58	73	71	73
8	51	38	43	33	34	35	52	51	57	68	70	73
9	51	40	42	33	34	36	49	50	65	68	72	70
10	52	42	43	32	34	38	48	50	68	69	73	70
11	49	42	40	32	35	38	49	51	71	69	71	68
12	51	43	41	33	34	36	48	51	72	71	68	63
13	55	45	41	33	32	38	46	50	74	74	66	62
14	53	45	39	33	33	38	49	53	74	74	66	64
15	52	46	39	33	34	37	49	57	74	76	69	63
16	55	46	36	33	35	36	49	58	75	73	71	60
17	55	46	33	33	35	37	50	61	68	70	71	61
18	58	47	33	33	33	38	47	60	67	73	68	62
19	56	45	33	33	33	41	49	61	69	72	71	62
20	58	46	33	-	34	43	53	58	72	72	71	64
21	58	47	34	33	34	-	57	57	74	73	69	64
22	56	50	37	33	34	35	60	56	77	71	70	60
23	58	55	34	32	33	38	62	56	78	71	70	58
24	56	50	34	33	33	40	55	58	73	71	72	58
25	55	49	33	34	33	43	56	60	74	72	74	60
26	54	46	33	33	34	44	56	61	77	72	74	60
27	54	45	34	34	35	44	55	62	76	73	67	59
28	55	42	35	32	35	43	55	60	69	75	69	61
29	56	41	36	32	-	45	52	65	68	75	67	62
30	53	41	37	34	-	49	52	60	67	75	68	67
31	52	-	35	32	-	39	-	66	-	76	68	-
Average	56	44	38	33	34	39	49	57	69	72	70	65

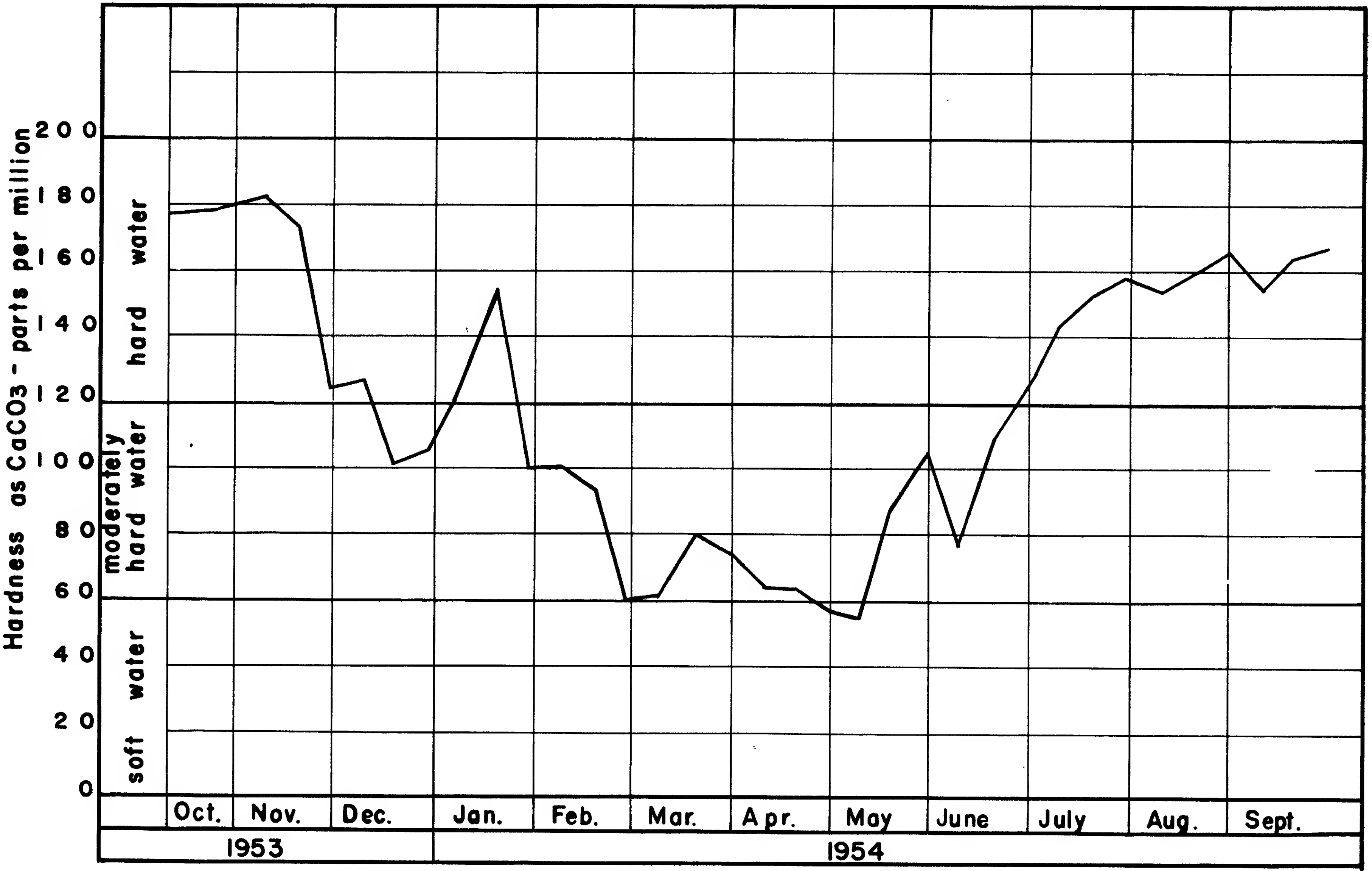

Figure 7. Hardness as $CaCO_3$ for periods shown

Chemung River at Chemung, N.Y.

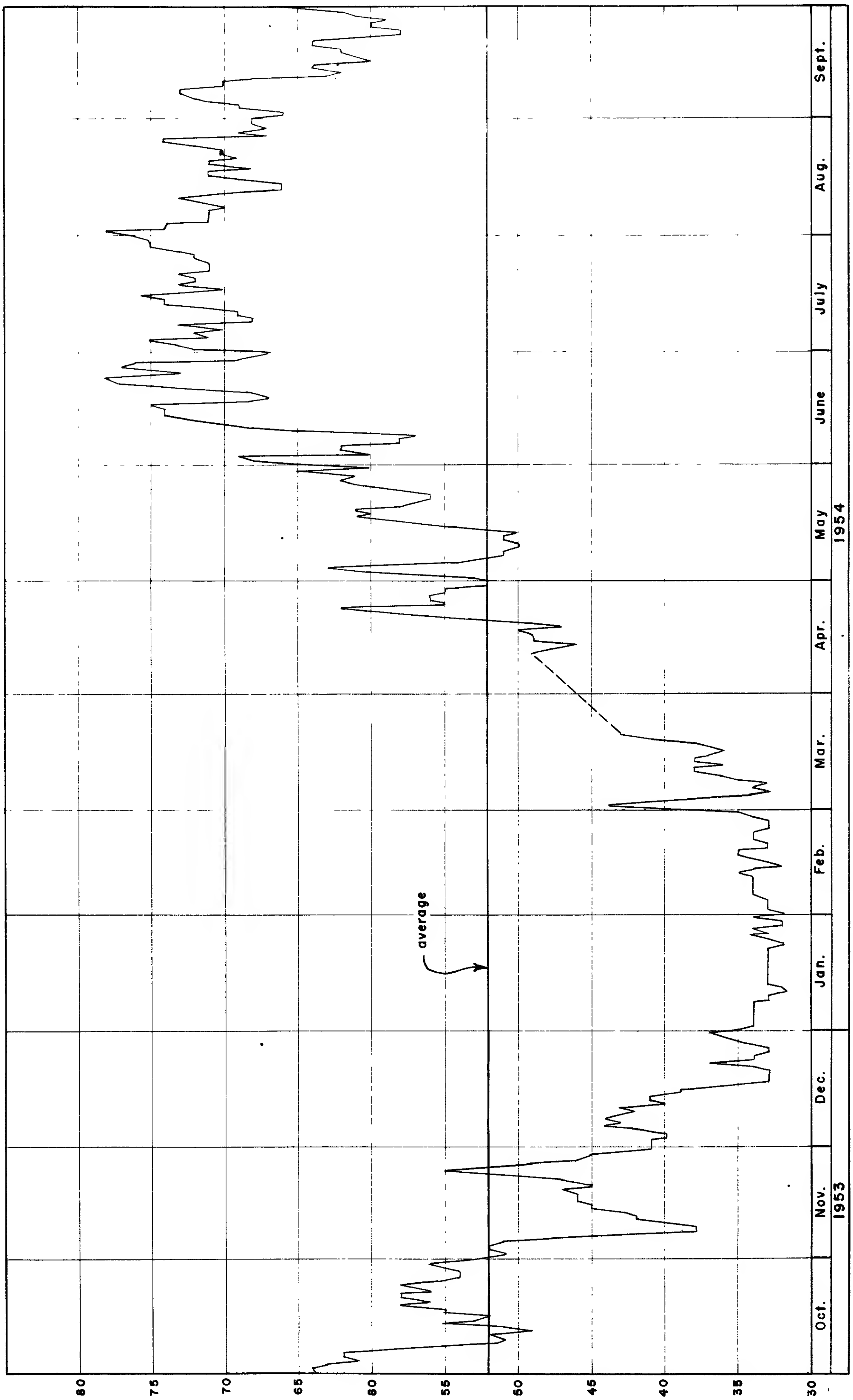

FIGURE 8. TEMPERATURE, CHEMUNG RIVER AT CHEMUNG, NEW YORK

TRIBUTARIES IN THE ALLEGHENY AND SUSQUEHANNA RIVER BASINS

In addition to the chemical quality-of-water data at station sites, water samples were also collected from selected tributaries in the Allegheny and Susquehanna River basins, the latter including the Chemung River. Chemical analyses are given in table 7. Streams are segregated according to basins, and in each basin they are arranged in downstream order. Analyses shown are representative of the chemical quality of these streams during high and low flow periods.

In the Allegheny River basin, a comparison of mineral concentrations during high and low flow stages will show that greater changes in concentrations took place in the Oswayo, Dodge, and Tunungwant Creeks than in any of the other tributaries. The following summary shows the ratio of dissolved solids during low flow to that during high flow for these streams.

	Ratio of dissolved solids at low and high flow
Oswayo Creek at Mill Grove, New York	2.3
Dodge Creek at Portville, New York	4.8
Tunungwant Creek at Limestone, New York	5.6

During the same periods the ratio of dissolved solids during low and high flows for the Allegheny River at Red House was 3.2. The changes in mineral content were due, primarily, to increases or decreases in chloride and calcium concentrations.

Table 7. - PERIODIC ANALYSES OF STREAMS IN NEW YORK

ALLEGHENY RIVER BASIN

9-268j

Chemical analyses, in parts per million, water year October 1952 to September 1953

Source	Date	Mean Dis-charge (cfs)	Silica (SiO_2)	Iron (Fe)	Cal-cium (Ca)	Mag-nesium (Mg)	Sodium (Na)	Potas-sium (K)	Bicar-bonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Dissolved solids (residue on evap-oration at 180°C)	Hardness as $CaCO_3$ Total	Hardness as $CaCO_3$ Non-carbon-ate	Specific conduct-ance (micro-mhos at 25°C)	pH	Color
Allegheny River at Mill Grove, N. Y.	4-15-53	a 1,310	3.8	0.23	8.2	2.1	.11	.7	17	13	22	0.1	0.5	78	29	15	134	6.9	8
" " "	8-20-53	a 96.3	3.3	.52	23	4.6	48	1.3	36	18	99	.1	.8	248	76	47	411	7.1	10
Oswayo Creek at Mill Grove, N. Y.	4-15-53	a 378	3.1	.30	14	3.5	24	.5	24	14	52	.2	.2	132	49	30	247	6.9	8
" " "	8-20-53	a 27.4	2.0	.39	27	5.9	56	1.7	42	21	116	.1	.6	303	92	57	490	7.2	5
Dodge Creek at Portsville, N. Y.	4-15-53	a 59.8	2.7	.19	16	3.7	28	1.2	26	14	60	.2	.4	150	55	34	275	7.2	5
" " "	8-20-53	a 2.55	.9	.19	61	13	118	2.6	62	22	284	.0	.6	733	206	155	1,070	7.4	10
Haskell Creek near East Olean, N. Y.	4-15-53	a 35.9	2.8	.18	8.2	1.9	1.5	.5	21	16	.6	.1	.6	46	28	11	73.0	7.0	8
" " "	8-20-53	a 1.65	1.7	.25	18	3.0	4.2	1.6	63	16	1.8	.1	.3	79	57	6	142	7.5	7
Oil Creek at Scott, N. Y.	4-15-53	a 56.6	2.1	.25	14	2.8	2.5	.9	41	17	1.0	.1	.6	67	46	13	114	7.1	4
" " "	8-20-53	a 3.07	2.8	.35	28	5.0	7.9	2.4	103	17	5.8	.0	1.1	134	91	6	216	7.4	15
Fivemile Creek at Allegany, N. Y.	4-15-53	a 47.2	3.6	.29	8.2	1.1	1.3	.7	20	9.2	1.6	.0	.7	41	25	9	66.0	7.3	10
" " "	8-20-53	0.00	2.2	.07	18	2.7	3.6	1.4	56	14	2.3	.1	.3	73	56	10	131	7.5	10
Olean Creek near Olean, N. Y.	4-15-53	a 227	2.5	.18	19	2.8	2.0	.6	58	19	1.4	.0	.7	85	57	11	139	7.6	4
" " "	8-20-53	a 20.5	2.4	.15	37	5.0	4.5	1.4	121	21	4.2	.0	.8	145	113	14	243	7.7	5
Tunungwant Creek at Limestone, N. Y.	4-15-53	a 293	4.0	.42	32	6.1	73	1.4	41	26	152	.2	.3	319	105	72	641	6.8	9
" " "	8-20-53	a 31.5	2.5	.77	146	37	425	2.4	125	93	908	.0	1.0	1,800	518	415	3,110	7.5	22
Great Valley Creek at Salamanca, N. Y.	4-15-53	165	2.5	.11	14	2.2	2.0	.6	39	17	1.5	.2	.4	65	44	12	102	8.2	6
" " "	8-20-53	2.5	5.0	.05	29	4.4	3.8	.8	96	17	4.2	.0	.7	116	90	12	201	8.0	5
Allegheny River at Red House, N. Y.	4-15-53	3,220	5.1	.27	15	2.4	16	.7	30	15	35	.1	.5	114	47	23	204	7.1	8
" " "	8-20-53	274	.9	.30	38	9.1	64	1.6	70	28	139	.0	.3	365	132	75	607	7.7	7
Red House Brook at Red House, N. Y.	4-15-53	a 53.7	3.5	.21	4.4	1.0	.7	.4	7	11	1.4	.1	.1	37	15	9	42.2	6.6	7
" " "	8-20-53	a 0.00	4.4	.07	8.7	2.0	2.2	.7	28	10	2.6	.0	.3	51	30	7	76.9	7.1	5
Allegheny River at Onoville, N. Y.	4-15-53	a 3,670	2.7	.23	15	2.5	15	.7	30	18	30	.1	.4	108	48	23	190	7.0	7
" " "	8-20-53	a 335	.9	.19	38	5.9	54	1.6	72	26	110	.1	.2	312	119	60	515	7.6	15

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Table 7. - PERIODIC ANALYSES OF STREAMS IN NEW YORK--Continued

ALLEGHENY RIVER BASIN--Continued

Chemical analyses, in parts per million, water year October 1952 to September 1953--Continued

Source	Date	Mean Dis-charge (cfs)	Silica (SiO_2)	Iron (Fe)	Cal-cium (Ca)	Mag-nesium (Mg)	Sodium (Na)	Potas-sium (K)	Bicar-bonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Dissolved solids (residue on evap-oration at 180°C)	Hardness as $CaCO_3$ Total	Hardness as $CaCO_3$ Non-carbon-ate	Specific conduct-ance (micro-mhos at 25°C)	pH	Color
Conewango Creek at Waterboro, N. Y.	4-16-53	357	2.4	0.40	27	3.7	2.1	1.3	81	22	1.8	0.0	1.0	129	83	16	178	7.4	20
" " "	8-21-53	57	4.7	.38	45	6.9	4.0	1.1	136	36	2.8	.1	.6	175	141	30	280	7.7	30
Chadakoin River at Falconer, N. Y.	4-16-53	305	2.3	.10	19	3.3	3.9	1.6	53	20	4.5	.1	1.4	90	61	18	143	7.0	6
" " "	8-21-53	17	5.2	.76	31	5.4	22	4.3	115	20	22	.5	.5	187	100	6	307	7.6	35
Cassadaga Creek at Ross Mill, N. Y.	4-16-53	a 178	1.2	.28	20	3.0	1.6	1.0	59	16	1.5	.0	.8	92	62	14	137	7.4	20
Levant, N. Y.	8-21-53	a 42.2	4.4	.54	31	5.1	14	2.2	106	30	8.0	.4	.3	152	99	12	247	7.2	35
Conewango Creek at Frewsburg, N. Y.	8-21-53	--	5.6	.34	38	6.1	7.1	2.5	113	30	8.0	.0	3.4	171	120	27	280	7.0	30
French Creek near Cutting, N. Y.	4-16-53	a 118	1.7	.26	19	3.0	1.5	.8	59	14	1.5	.0	1.0	87	60	11	133	7.3	20
" " "	8-21-53	a 6.96	2.6	.29	34	6.9	2.8	1.3	117	21	3.4	.2	.3	137	113	18	236	7.7	20
SUSQUEHANNA RIVER BASIN																			
Susquehanna River at Colliersville, N.Y.	4-23-53	401	2.0	.16	31	1.8	2.1	.6	91	12	1.2	.0	.3	108	85	10	175	7.6	8
" " "	8-18-53	29	1.2	.08	37	2.7	2.6	1.1	115	15	2.0	.0	.3	124	104	9	218	7.7	20
Unadilla River near New Berlin, N. Y.	4-23-53	300	2.3	.17	35	2.1	2.2	.6	103	18	2.1	.1	.6	130	96	12	202	7.9	6
" " "	8-18-53	33	2.2	.26	50	3.2	3.8	1.1	137	28	4.0	.1	.6	166	138	26	280	7.7	25
Susquehanna River at Conklin, N. Y.	4-22-53	4,440	2.8	.06	15	1.9	3.1	1.6	44	12	2.3	.1	1.2	68	45	9	105	7.1	6
" " "	8-18-53	313	1.4	.18	26	2.7	3.7	.7	78	16	3.2	.0	.3	93	76	12	168	7.5	15
Chenango River at Greene, N. Y.	4-23-53	895	2.8	.14	26	3.0	2.2	1.0	83	15	2.6	.0	1.5	96	77	9	174	7.6	7
" " "	8-18-53	112	1.8	.21	42	7.2	4.1	1.4	141	21	3.6	.0	.3	160	135	26	261	8.4	20
Otselic River near Upper Lisle, N. Y.	4-23-53	346	2.6	.16	12	1.7	1.6	.8	33	9.6	2.0	.0	1.2	62	37	10	84.4	6.9	20
" " "	8-18-53	20	1.5	.31	22	2.7	3.4	.7	71	12	3.4	.0	.2	94	66	13	147	8.4	15
Tioughnioga River at Itaska, N. Y.	4-23-53	1,230	2.3	.21	23	2.9	1.9	.9	69	17	2.1	.1	1.6	101	69	13	156	7.5	8
" " "	8-18-53	98	2.1	.26	39	5.6	6.6	1.2	128	20	8.8	.1	.4	155	120	15	260	8.6	3

Table 7. - PERIODIC ANALYSES OF STREAMS IN NEW YORK—Continued

SUSQUEHANNA RIVER BASIN--Continued

9-268j

Chemical analyses, in parts per million, water year October 1952 to September 1953--Continued

48586

Source	Date	Mean Discharge (cfs)	Silica (SiO_2)	Iron (Fe)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Dissolved solids (residue on evaporation at 180°C)	Hardness as $CaCO_3$ Total	Hardness as $CaCO_3$ Non-carbonate	Specific conductance (micromhos at 25°C)	pH	Color
Nanticoke Creek at Union, N. Y.	4-23-53	a 112	1.9	0.13	7.7	2.1	2.0	.9	20	14	2.0	0.0	0.8	55	28	11	72.1	7.0	20
" " "	8-18-53	a 1.54	4.3	.22	16	2.6	5.1	1.4	48	15	6.0	.1	.2	83	51	12	133	7.1	1
Catatonk Creek at Candor, N. Y.	4-23-53	a 145	3.7	.13	22	3.9	1.9	1.0	72	20	1.6	.0	1.4	92	71	12	157	7.6	13
" " "	8-18-53	a 14.6	3.8	.43	35	7.9	3.5	1.1	134	16	4.0	.1	1.2	142	120	10	245	8.0	2
Owego Creek near Owego, N. Y.	4-23-53	266	2.6	.10	18	3.0	50	.9	52	14	80	.0	1.1	217	57	14	380	7.2	20
" " "	8-18-53	13	5.0	.12	36	6.0	6.9	1.0	118	17	12	.1	2.1	148	115	18	256	7.9	0
Cayuta Creek at Waverly, N. Y.	4-23-53	a 131	2.8	.14	15	2.6	2.5	.8	46	15	2.2	.0	.7	82	48	10	117	7.3	10
" " "	8-18-53	a 14.4	2.9	.17	31	5.0	3.8	1.1	102	19	4.0	.1	.4	119	98	14	205	8.1	1
Susquehanna River near Waverly, N. Y.	4-23-53	8,170	2.2	.23	19	2.2	5.6	.8	53	15	7.9	.1	.6	91	56	13	146	7.4	13
" " "	8-18-53	670	2.4	.26	36	4.8	17	1.6	116	25	18	.1	.8	169	110	15	285	7.7	4
Canisteo River at Arkport, N. Y.	8-19-53	2.1	5.8	.16	52	10	3.6	1.8	186	23	2.4	.1	.3	202	171	19	331	8.0	2
Karr Valley Creek at Almond, N. Y.	4-22-53	22	2.5	.11	19	3.6	2.4	1.6	61	18	1.6	.5	.7	92	62	12	139	7.3	7
" " "	8-19-53	1.1	5.6	.66	47	8.1	3.6	1.7	168	19	2.0	.0	.5	181	151	13	303	8.3	3
Canacadea Creek near Hornell, N. Y.	4-22-53	58	2.0	.29	29	5.3	2.9	1.1	96	24	2.4	.0	.0	131	94	25	202	8.8	7
" " "	8-19-53	8.6	4.7	.24	53	14	4.9	2.1	198	35	2.6	.1	.5	217	190	28	364	8.2	2
Canisteo River below Canacadea Creek at Hornell, N. Y.	4-22-53	139	2.0	.08	39	1.9	2.3	1.6	105	26	2.8	.1	.7	149	105	19	234	7.2	12
" " "	8-19-53	22	2.7	.46	57	13	8.6	1.8	206	39	6.8	.1	1.1	239	196	27	394	8.3	1
Canisteo River at West Cameron, N. Y.	4-22-53	e330	2.1	.19	29	4.8	8.7	1.0	91	32	5.3	.0	.0	130	92	18	212	8.1	7
" " "	8-19-53	38	2.4	.37	52	11	19	2.7	184	40	22	.1	.2	244	175	24	405	8.6	3
Tuscarora Creek near South Addison, N. Y.	4-22-53	66	1.7	.09	18	1.9	3.4	1.8	49	18	3.0	.0	.3	88	53	13	135	7.6	10
" " "	8-19-53	1.4	3.7	.17	30	3.4	5.9	2.1	92	18	6.4	.1	.2	117	89	14	204	7.9	1
Tioga River near Erwins, N. Y.	4-22-53	1,190	2.3	.26	22	3.1	9.0	1.4	57	34	7.4	.1	.1	122	48	21	182	7.5	8
" " "	8-19-53	94	2.9	.31	39	7.8	12	2.2	89	69	15	.0	.4	211	130	57	314	7.6	27

Table 7. - PERIODIC ANALYSES OF STREAMS IN NEW YORK—Continued

SUSQUEHANNA RIVER BASIN—Continued

9-268j

Chemical analyses, in parts per million, water year October 1952 to September 1953—Continued

Source	Date	Mean Dis-charge (cfs)	Silica (SiO_2)	Iron (Fe)	Cal-cium (Ca)	Mag-nesium (Mg)	Sodium (Na)	Potas-sium (K)	Bicar-bonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Dissolved solids (residue on evap-oration at 180°C)	Hardness as $CaCO_3$ Total	Hardness as $CaCO_3$ Non-carbon-ate	Specific conduct-ance (micro-mhos at 25°C)	pH	Color
Tenmile Creek near Avoca, N. Y.	4-22-53	a 16.8	2.6	0.14	13	3.1	2.5	1.0	21	22	7.0	0.0	2.7	86	45	28	121	7.3	10
" " "	8-19-53	a .820	2.3	.16	21	4.0	3.5	1.5	60	25	4.2	.0	.3	105	69	20	159	7.7	18
Cohocton River at Avoca, N. Y.	4-22-53	a 170	2.9	.17	32	4.7	2.7	1.1	90	24	6.0	.0	1.9	127	141	25	220	7.8	8
" " ""	8-19-53	a 44.3	4.8	.20	43	8.1	2.9	1.5	148	24	6.1	.1	.6	176	141	20	286	7.9	22
Fivemile Creek near Kanona, N. Y.	4-22-53	81	1.7	.08	20	4.3	3.6	1.8	55	26	4.4	.2	1.8	121	68	23	160	7.3	15
" " "	8-19-53	3.4	1.9	.12	38	12	4.5	1.4	140	34	4.9	.1	1.0	186	145	30	296	7.3	21
Campbell Creek near Kanona, N. Y.	4-22-53	a 20.8	3.1	.13	19	2.7	2.6	1.2	55	19	2.5	.0	.4	90	58	13	134	7.4	5
" " "	8-19-53	a 1.07	4.6	.12	32	7.0	4.4	1.9	121	20	3.2	.1	.5	136	109	10	230	8.1	12
Mud Creek near Savona, N. Y.	4-22-53	25	1.7	.39	23	5.3	4.1	1.0	78	18	2.8	.0	.0	116	79	15	176	7.7	12
" " "	8-19-53	1.4	3.0	.19	29	14	4.5	.8	144	19	2.2	.1	.8	150	130	12	256	8.0	26
Cohocton River near Campbell, N. Y.	4-22-53	424	2.4	.15	29	5.1	3.2	1.2	82	25	4.9	1.3	1.5	137	93	26	212	7.6	12
" " "	8-19-53	74	2.1	.20	34	14	4.8	1.5	146	30	6.1	.1	1.3	171	143	23	288	8.2	18
Meads Creek near Coopers Plains, N.Y.	4-22-53	a 55.8	3.1	.12	7.9	2.5	2.6	1.1	21	14	2.0	.0	.5	53	30	13	78.1	7.0	10
" " "	8-19-53	a 1.86	3.3	.33	16	3.6	3.7	1.6	58	15	2.6	.1	.2	75	55	7	132	7.8	12
Chemung River at Chemung, N. Y.	4-22-53	2,180	1.7	.17	24	4.1	5.0	1.6	68	25	6.5	.0	1.2	132	77	21	189	7.6	20
" " "	8-19-53	296	1.6	.15	39	9.8	11	2.0	123	45	13	.1	1.8	198	138	37	324	7.8	25

Estimated
Instantaneous

Susquehanna River and its many tributaries form an extensive network throughout central New York. Susquehanna River at Waverly drains an area of about 4,920 square miles. Its major tributary, Chemung River, has a drainage area of 2,530 square miles at Chemung. Since both of these locations are at the borderline between New York and Pennsylvania, total drainage area of Susquehanna River basin in New York State is about 7,450 square miles.

The chemical quality of the Susquehanna River fluctuated along the main stem starting near Colliersville and proceeding downstream to Waverly.

Location	Dissolved Solids (ppm)	
Susquehanna River at:		
Colliersville	108 (April 23, 1953)	124 (Aug. 18, 1953)
Conklin	68 (April 22, 1953)	93 (Aug. 18, 1953)
Near Waverly	91 (April 23, 1953)	169 (Aug. 18, 1953)

These changes in concentrations of mineral matter in solution reflect, primarily, decreases and increases of concentrations of calcium bicarbonate. Along with changes in calcium concentrations, variations in hardness took place, because calcium is one of the chemical elements responsible for hardness. Other cations and anions were present in lesser and more uniform concentrations, but their presence did not materially affect the changes in dissolved mineral matter as noted above.

However, iron, although relatively low in concentration in comparison with other cations, deserves special consideration because

of its effect. In water samples collected at Colliersville and Conklin, lower concentrations were noted than at Waverly. Here, during high and low flows, concentrations were 0.23 and 0.26 ppm, respectively. These concentrations could be troublesome if the water were used industrially as process water for canning, manufacture of fine paper and other sensitive processes.

Similarily, comments made about the Susquehanna River would apply to its tributaries. Variations were noted in dissolved solids and hardness during periods of high and low flows. Again these changes reflect increases and decreases in concentrations of calcium bicarbonate. Iron concentrations exceeding 0.3 ppm were present in water samples from Otselic River near Upper Lisle and Catatonk Creek at Candor during a period of low flow on August 18, 1953.

It will be noted in reviewing table 7 (Canisteo River to Chemung River) that during the period of sampling, Chemung River and its tributaries, with few exceptions, contain larger concentrations of dissolved mineral matter than Susquehanna River and its tributaries. Qualitatively, the chemical composition is similar--primarily calcium bicarbonate. However, concentrations are greater and account for the over-all increase in mineral content. In addition, greater concentrations of magnesium are present. Because of higher concentrations of calcium and magnesium, surface waters in the Chemung River basin are harder, especially during low flow. Higher concentrations of iron were also more prevalent during periods of low flow.

CHEMICAL QUALITY OF GROUND WATER IN THE ALLEGHENY AND CHEMUNG RIVER BASINS

A limited number of chemical analyses were made of ground waters in the Allegheny and Chemung River basins. The data are not based on a comprehensive study of the chemical quality of ground water resources in these basins, but only represent the chemical quality of some ground waters already in use and merely indicate the chemical quality that may be expected in the same areas. Eleven of the sources are for private use. Only one (No. 10, table 9) is owned by the town of Hinsdale, Cattaraugus County.

Three of the water samples (Nos. 3, 9, & 10, table 8) were collected from wells in gravel deposits. Generally, the chemical compositions were similar. The three waters contained moderate amounts of dissolved mineral matter. The average concentration of dissolved solids was 156 ppm. Average hardness due primarily to calcium was 120 ppm. Water from these sources would lather with difficulty and form an insoluble curd. Other anions and cations, including iron and manganese, were not present in sufficient quantity to affect the utility of the water.

Only one analysis is available of ground water from sandstone. Generally, the chemical composition was similar to that of water from gravel deposits. However, in addition to calcium salts in solution, larger quantities of sodium bicarbonate were present. The iron concentration in the water sample (No. 7, table 8) was 0.44 ppm, and the manganese concentration was 0.49 ppm. Water from this source would be

troublesome because iron and manganese compounds would precipitate from solution and give an unsightly appearance to laundry and porcelain fixtures.

Some differences in chemical composition were found in the three water samples collected from sandstone and shale. The average of dissolved solids for these analyses was 219 ppm. Water from all three sources was hard due, primarily, to calcium bicarbonate and to a lesser extent magnesium bicarbonate. Iron exceeded 0.30 ppm in two of the samples with a high of 0.76 ppm in a water sample from Chemung County (No. 2, table 8). Water from these sources would also be troublesome unless suitable treatment was applied.

The chemical quality of waters from shale and siltstone differed considerably. Dissolved solids in the four samples ranged from 155 to 374 ppm. Generally, the chemical composition consisted, primarily, of calcium and bicarbonate with lesser amounts of sodium, sulfate, and chloride. Water from one well (No. 12, table 8, 9) northeast of Portville was unusual in quality. Its chemical composition was mainly sodium bicarbonate with very low concentrations of calcium and magnesium--2.6 and 0.1 ppm, respectively. Water from this source was also very soft, having a hardness of 7 ppm whereas all other ground waters in this group were moderately hard or hard. Other anions and cations including iron and manganese were not present in sufficient quantity to affect the utility of the waters.

Only one analysis of water from shale is reported here. The water from this source contained only moderate amounts of dissolved solids and was moderately hard. Iron concentration was 0.21 ppm and if present, alone, would not necessarily be troublesome. However, the

concentration of manganese was 0.14 ppm. Together, with concentrations of iron and manganese could become a problem requiring some form of treatment in order to make water from this source satisfactory.

Chemical and some well data are given in tables 8 and 9.

Table 8 - MISCELLANEOUS GROUND WATER ANALYSES

Analyses by Geological Survey, United States Department of the Interior
(parts per million)

36631

a	1	2	3	4	5	6
Date of collection	8/27/53	8/29/53	8/29/53	8/29/53	8/27/53	8/26/53
Silica (SiO_2)	9.6	8.8	7.8	10	11	6.7
Iron (Fe), dissolved 1/	.02	.00	.00	.00	.21	.00
Iron (Fe), total	.39	.76	.03	.09	.21	.19
Manganese (Mn), dissolved 1/	.02	.04	.00	.00	.08	.00
Manganese (Mn), total	.03	.07	.02	.00	.14	.00
Calcium (Ca)	34	40	39	52	28	37
Magnesium (Mg)	8.1	13	5.6	10	6.1	5.4
Sodium (Na)	37	8.2	3.4	13	12	11
Potassium (K)	2.8	.7	1.0	.2	1.3	.8
Bicarbonate (HCO_3)	226	166	119	198	121	144
Carbonate (CO_3)	0	0	0	0	0	0
Sulfate (SO_4)	1.0	34	24	39	18	20
Chloride (Cl)	17	1.8	1.9	.3	3.9	4.2
Fluoride (F)	.1	.1	.0	.0	.2	.0
Nitrate (NO_3)	.2	2.1	5.0	.1	.2	.1
Dissolved solids						
Sum						
Residue on evaporation at 180°C	232	199	161	226	145	155
Hardness as $CaCO_3$	118	154 b	120	171 b	96 b	115
Non-carbonate	0	18	23	9	0	0
Specific conductance (micromhos at 25°C)	393	330	261	355	234	272
pH	7.6	7.0	7.6	7.6	7.8	7.8
Color	3	3	5	4	2	2

1/In solution at time of analysis.
a Numbers refer to position in Table 9. - WELL DATA
b Includes hardness of all polyvalent cations reported

Table 8 - MISCELLANEOUS GROUND WATER ANALYSES--*Continued*

Analyses by Geological Survey, United States Department of the Interior
(parts per million)

36631

a	7	8	9	10	11	12
Date of collection	8/26/53	8/26/53	8/27/53	8/27/53	8/27/53	8/27/53
Silica (SiO_2)	6.1	6.4	7.8	5.8	9.8	7.5
Iron (Fe), dissolved 1/	.17	.00	.03	.00	.01	.04
Iron (Fe), total	.44	.11	.17	.05	.25	.13
Manganese (Mn), dissolved 1/	.45	.01	.00	.01	.10	.01
Manganese (Mn), total	.49	.02	.00	.01	.12	.02
Calcium (Ca)	36	39	41	40	30	2.6
Magnesium (Mg)	4.5	5.0	2.9	6.3	19	.1
Sodium (Na)	22	5.8	2.9	2.9	35	140
Potassium (K)	1.7	1.5	.7	1.0	1.8	1.3
Bicarbonate (HCO_3)	185	125	115	124	214	256
Carbonate (CO_3)	0	0	0	0	0	15
Sulfate (SO_4)	1.2	24	19	26	29	27
Chloride (Cl)	8.9	2.1	2.2	1.3	19	41
Fluoride (F)	.1	.1	.1	.0	.2	.5
Nitrate (NO_3)	.2	1.9	6.5	.8	.1	.2
Dissolved solids						
Sum						
Residue on evaporation at 180°C	176	163	146	160	249	374
Hardness as $CaCO_3$	110	119 b	114	126	153	7
Non-carbonate	0	16	20	24	0	0
Specific conductance (micromhos at 25°C)	307	262	239	256	436	631
pH	7.2	7.2	7.7	8.0	7.6	8.8
Color	5	3	3	3	3	3

1/In solution at time of analysis.
a Numbers refer to position in Table 9. - WELL DATA
b Includes hardness of all polyvalent cations reported

Table 9 - WELL DATA

NUMBER	TYPE OF WELL	DEPTH (ft.)	DIAMETER (in.)	WATER-BEARING MATERIAL	YIELD (gpm)	LOCATION
1	Drilled	99	4	Sandstone and Shale	5	Along shore of Cuba Lake about 2.6 miles northwest of Cuba, Allegany County (Fld. No. Ag 97)
2	Drilled	50	6	Sandstone and Shale	5	About 0.6 mile south of Chemung and 6.7 miles west of Elmira, Chemung County (Fld. No. CM 93)
3	Drilled	45	6	Gravel	30	3.4 miles northwest of Horseheads, Chemung County (Fld. No. CM 185)
4	Drilled	150	6	Sandstone and Shale	300	1.6 miles southwest of Breesport, Chemung County (Fld. No. CM 355)
5	Drilled	189	6	Shale	5	1.6 miles southwest of Salamanca, Cattaraugus County (Fld. No. Ct 181)
6	Drilled	50	6	Shale and Siltstone	25	0.5 mile northeast of Humphrey, Cattaraugus County (Fld. No. Ct 185)
7	Drilled	50	6	Sandstone	50	6.2 miles northeast of Ellicottville, Cattaraugus County (Fld. No. Ct 188)
8	Drilled	55	6	Shale and Siltstone	30	At Ashford, Cattaraugus County (Fld. No. Ct 193)
9	Drilled	61	8	Gravel	219	2.5 miles southeast of Olean, Cattaraugus County (Fld. No. Ct 203)

Table 9 - WELL DATA--*Continued*

NUMBER	TYPE OF WELL	DEPTH (ft.)	DIAMETER (in.)	WATER-BEARING MATERIAL	YIELD (gpm)	LOCATION
10	Drilled	73	8	Gravel	100	0.7 mile northwest of Hinsdale, Cattaraugus County (Fld. No. Ct 205)
11	Drilled	65	6	Shale and Siltstone	25+	1.4 miles southeast of Limestone, Cattaraugus County (Fld. No. Ct 216)
12	Drilled	245	6	Shale and Siltstone	87	1.9 miles northeast of Portville, Cattaraugus County (Fld. No. Ct 231)